THE FOUNDRY

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How Stove Plate is Molded on Squeezers

Description of the Methods of the Modern Stove Co., Chicago Heights, Ill., Which Have Resulted in Remarkable Reductions in the Cost of Molding

REDUCTION in the total cost of molding a certain stove from $1.05 to 47 cents is sufficiently great to merit more than a passing comment. This result has been achieved at the plant of the Modern Stove Co., Chicago Heights, Ill., through the introduction of air squeezers operated in connection with aluminum match-plates. It was from the invention of the hinged match-plate that the stove foundrymen of the country obtained their first emancipation from hand labor. Great as this advance was at the time of its introduction, it is now evident that for a large proportion of stove foundry work, even greater economy can be realized through the use of match-plates adapted for machine molding. The traditional hostility of stove molders toward the introduction of machines probably accounts for the comparatively slow progress that advanced methods have made in stove foundries more than any other one cause. Therefore, any discussion of the introduction of machines in a stove foundry would be incomplete without explaining how the labor aspects of the problem were solved.

At the plant of the Modern Stove Co. squeezer machines are used almost exclusively, and the men are paid on a straight piece rate basis. Most of the work is being done with what ordinarily would be called unskilled labor; that is, there are practically no men in the shop who would be classed as molders in an ordinary foundry. At the same time a consistent effort is made by the management to encourage the men by so arranging the rates that they can earn at least 50 per cent more than the ordinary day wage for unskilled labor. Also it is part of the duty of the foremen

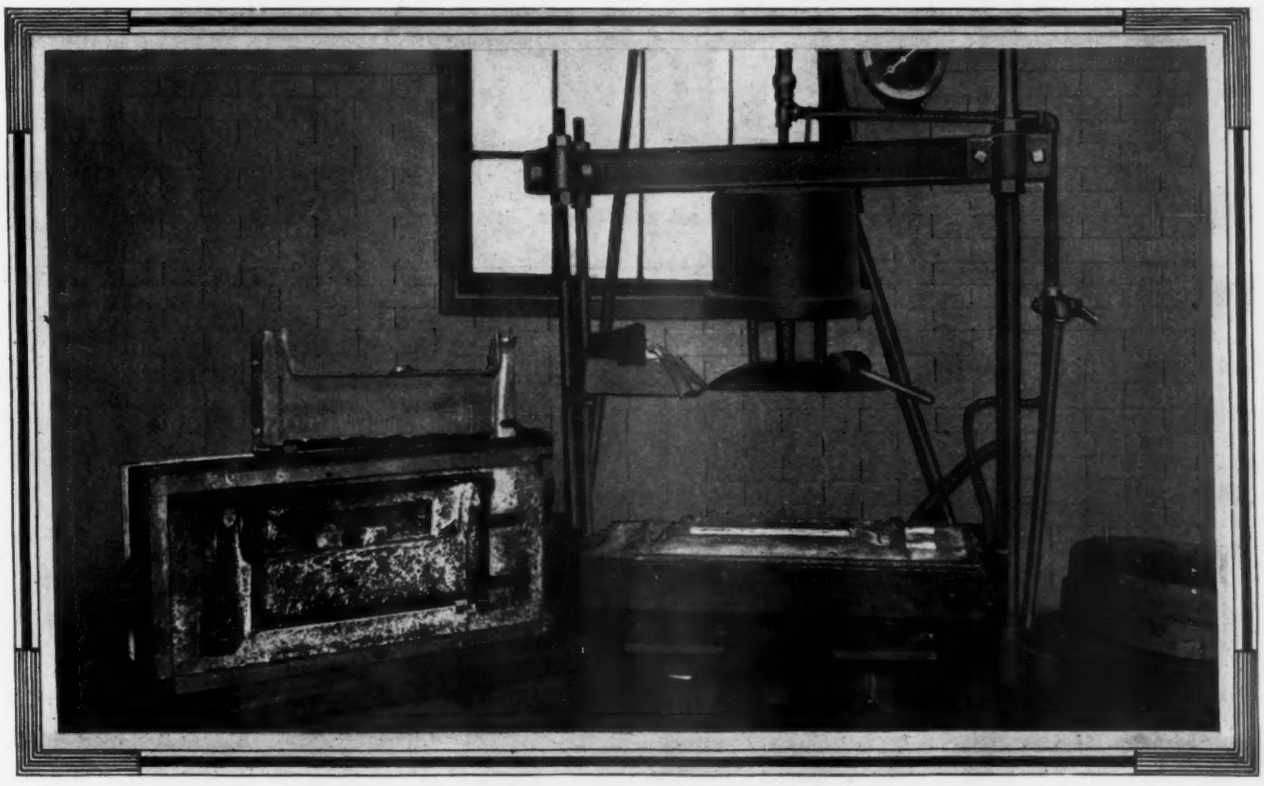


FIG. 1—MOLDING A WATER FRONT ON A 32-INCH SQUEEZER

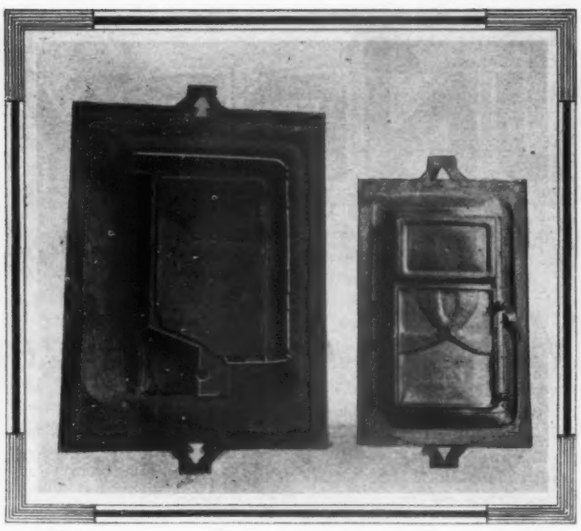


FIG. 2—STOVE SIDE AND FRONT FOR HEATER MOLDED ON SQUEEZER

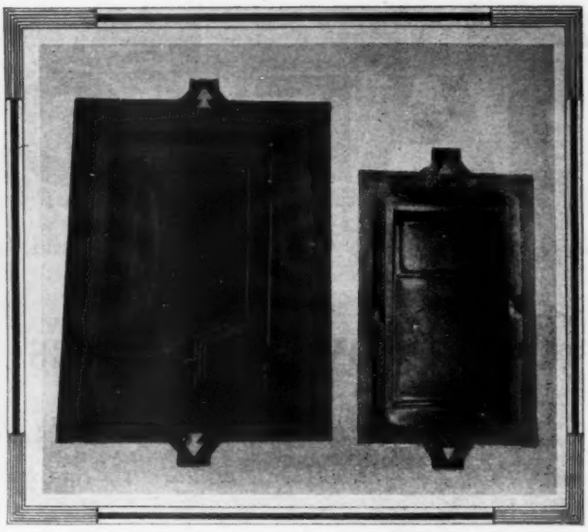


FIG. 3—REVERSE SIDE OF MATCH-PLATES SHOWN IN FIG. 2

to teach the men the fine points of their work and to explain to them the reasons for the various operations. In other words, an effort is made to make the shop work interesting for the laborer, so that he will be willing to remain continuously in the employ of the firm. In this way a stable, efficient organization has been built up which effectively solves the labor problem.

The molding department of the Modern Stove Co.'s foundry is 200 feet long and 70 feet wide. Ordinarily about 60 molders are employed. The floors are arranged in the standard stove foundry manner with the machines placed against the walls on each side of the shop. At the present time 18 air squeezers are employed; of this number 17 were furnished by the J. F. Webb Mfg. Co., Davenport, Ia., and one by the Arcade Mfg. Co., Freeport, Ill. The machines range in size from 32 to 54 inches between standards.

At the present time about 362 pounds of good castings are obtained per man per day. This figure would probably be higher, were it not for the fact that it is necessary for each man to change his pattern 10 or 12 times daily. The men do not get the benefit which comes from long continued practice on one particular mold. This situation arises from the fact that the shop, which is comparatively small, turns out a full line of stoves both for heating and cooking purposes. Nevertheless, the use of molding machines and match-plates has brought about an average reduction in the piece prices of 35 per cent compared with those prevailing a couple of years ago, when the shop was operating on a hand-work basis. Of course, some of the larger plates are still molded on the floor and if only that portion of the output which has been transferred from the floor to the machines is considered, the reduction in the piece rates averages from 50 to 55 per cent. At the same time, as previously explained, the wages of the men are at least 50 per cent above the prevailing day rates.

Fig. 1 shows how a water front for a cook stove is molded on a squeezer machine with the aid of an aluminum match-plate. The casting weighs about 19 pounds and a dry sand core is used to form the interior passageway for the water. A 12 x 18-inch snap flask is employed, the molds being secured in wooden jackets when they are poured. The machine, which was furnished by the J. F. Webb Mfg. Co., is 32 inches between standards. About 100 molds are turned out per day, the workman earning approximately $3.50. The machine is provided with a riddle bracket, and a heavy

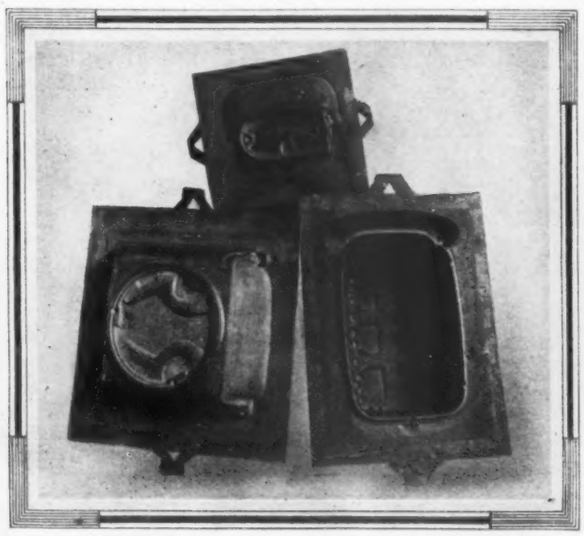


FIG. 4—LARGE PLATES MOLDED ON SQUEEZERS

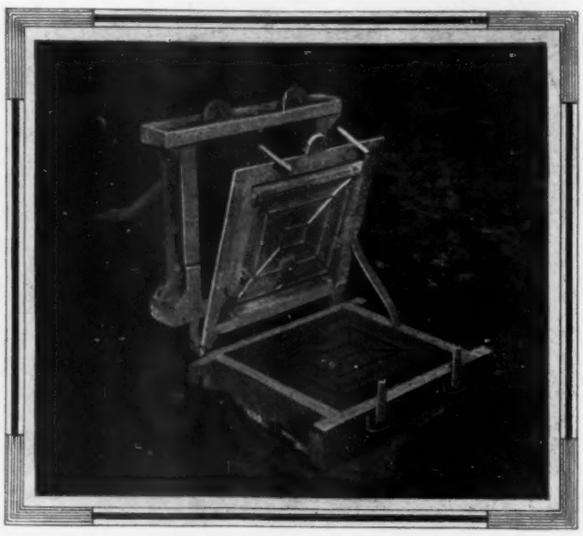


FIG. 5—HINGED MATCH PLATE MOLDED ON FLOOR

bench also is furnished for holding the molder's miscellaneous tools. Both the cope and the drag are squeezed at the same time. In Fig. 1 the cope is shown on the bench at the left and one of the finished castings may be seen standing on top of the cope. The method of gating is clearly illustrated.

Although the molding machines are provided with pressure gages, they are not used by the workmen. Each machine also is equipped with an adjustable reducing valve which may be set so that the mold will be given any desired degree of compression. These valves are adjusted by the foreman to fit the particular plate that is being handled, and the molder, therefore, does not have to pay any attention to the squeezing pressure. He simply opens the operating valve to its widest extent and knows that the mold will be properly squeezed. This, of course, saves considerable time and also makes it certain that the molds will all be rammed to a uniform density. A pressure of 45 pounds per square inch is maintained in the main air lines.

Both sides of two large squeezer plates are illustrated in Figs. 2 and 3. The larger plate, shown at the left, forms the side of a cook stove oven. The cope side of this plate is shown in Fig. 2 and the drag side in Fig. 3. The gate, which consists of a runner with four fingers leading to the mold, is clearly shown in the latter illustration. The pocket in Fig. 2 is formed by a green sand core suspended from the cope, which is not provided with bars. Several nails or gaggers, however, are used to hold the sand in place. The pocket is 4½ inches in depth and the gaggers are permanently fastened to the cope. The plate is 20 x 26 inches in size and the casting weighs 18 pounds. This is one of the largest plates handled on the squeezer machines. A molder and a helper put up 60 flasks per day; the helper is paid a flat rate of $2 for his day's work, while the molder gets 8 cents per casting. The flasks are suitably weighted when they are poured. Only 25 oven frame molds of this size were made per day by hand, and the piece rate was double what it is now; nevertheless, the molder now earns 20 per cent more. The heater front shown at the right in Figs. 2 and 3 is molded on a squeezer machine in a 14 x 22-inch snap flask. The pocket shown in Fig. 3 is 3½ inches deep but no trouble has been experienced from molds caving in. The gate is shown clearly in Fig. 2. There is one runner which extends down through the cope to the center of the star gate formed in the drag. It will be noted that the door hinges and latch bracket are an integral part of the match plate.

Fig. 4 shows three interesting plates which are molded on squeezers. The smaller one at the top is a flue pocket; the plate at the left is used for molding the bases of round oak stoves, while the one at the right forms the fire pots for the same stove. The flue pocket is squeezed in a 12 x 14-inch snap flask, the cope being 9 inches and the drag 2½ inches in depth. The pocket is 6 inches deep and is formed by a green sand core which stands on the drag and extends up into the cope. The casting weighs three pounds and the daily production is 140 molds.

The round oak base shown at the left in Fig. 4 is molded in a solid box, 20 inches square, the cope being 9 inches and the drag 3 inches in depth. The cavity in the plate, which is 5 inches deep, is formed by a green sand core which is formed in the drag. The copes are not provided with bars, the sand being rammed to sufficient density to hold it in place. The casting weighs 12 pounds, the metal being 1/10-inch in thickness. There are two runners, each of which connects with a three-part gate, as shown in the illustration.

FIG. 6—MOLDING ROOM OF MODERN STOVE CO.'S FOUNDRY

The deep fire pot shown at the right in Fig. 4 also is molded in green sand in the same manner as the round oak base. The depth of the pocket in this case is 7½ inches, the plate measuring 11 x 17½ inches. The casting weighs 21 pounds, and one man and a helper put out 200 molds in a day. Figs. 7 and 8 illustrate the method of molding a fire pot of somewhat smaller size on an Arcade swing head squeezer. In this case a 16-inch snap flask is used, the cope being 9 inches and the drag is 3 inches in depth.

It is more economical to handle

FIG. 7—SQUEEZING A DEEP FIRE POT

some of the work on the floor, using hinged match-plates. Fig. 5 shows a top oven plate which is made in this manner in a 16 x 18-inch flask. The match-plate was furnished by the Goodale Co., Kalamazoo, Mich., and is provided with Goodale hinges and flask pins, which insure an accurate roll-up and print-back. The cope is fitted with two bars to hold the sand in place. Sixty molds constitute an ordinary day's work, the piece rate being 4½ cents.

Aluminum Match-Plates

The Modern Stove Co. makes a great many of its own match-plates out of a special aluminum alloy furnished by the United States Reduction Co., East Chicago, Ind. This alloy consists of 93 per cent aluminum and 7 per cent zinc. This metal shrinks 5/32 inch per foot. A master plate, in which provision has been made both for aluminum and iron shrinkage, is usually made of white metal in the pattern shop, and from it the working plates are cast, suitable provision being made between the cope and the drag for the proper plate thickness. If a plate is to be made from an iron casting, a mold is rammed in the usual manner and the resulting white metal plate is cut into several parts and "stretched" to allow for the double shrinkage. The cracks in the "stretched" plate are filled with solder and a new working plate is then made in a mold.

The shop is provided with a Colliau cupola lined to 48 inches in diameter. An ordinary stove plate mixture consists of 50 per cent pig iron and 50 per cent return sprue. A nominal amount of 80 per cent ferro-silicon is used. The spoiled castings during the year 1913 amounted to 3 per cent of the total melt. This is in harmony with ordinary good stove shop practice.

FIG. 8—FIRE POT MOLDED IN SNAP FLASK

Will Make Foundry Rigs

Everett D. Betts and John A. Elliott, foundry specialists, have organized the firm of Betts & Elliott and established a shop at 654 Franklin street, Detroit. The new partnership will devote its attention to the design and construction of rigs for handling difficult molding work in malleable, gray iron and steel foundries. The shop is also equipped to make dies for straightening malleable castings. The firm does not intend to manufacture molding machines, but to build rigging for turning out castings that cannot profitably be made with ordinary standard equipment. Both partners have been engaged in the foundry business for over 20 years, and have recently held responsible positions with the Michigan Malleable Iron Co., from which they resigned to launch the new venture.

The Duplex Shaker Works, Chicago, has sold its business, equipment, patents and good will to the Brown Specialty Machinery Co., 2448 West Twenty-second street, Chicago. The device manufactured by the Duplex Shaker Works consists of a motor-driven machine provided with two sand shakers, the invention of Ira E. Burtis, vice president of the James A. Brady Foundry Co. The Brown Specialty Machinery Co., which manufactures core machines and other core shop equipment, will add the Duplex shaker to its line.

How to Make Your Time Studies Accurately*

Scientific Management is Based on Time Studies, Which Must Be Accurate to be of Any Use

By C E Knoeppel

IN A recent issue of a popular magazine, Frank Barkley Copley told how, at the Watertown, Mass., arsenal, a time study expert studied the molding of pommels for pack saddles. The average making time was 53 minutes per mold. After the proper study and analysis the operation was standardized and a time of 24 minutes decided upon—a reduction of 29 minutes. He states that the first man who worked on the schedule had no trouble in making the molds day after day, in an average time of 20 minutes each, and to show what could be done, if the man wanted to see how far he could go, he made the molds for one day at the rate of 16 minutes each and one mold was made in 10 minutes. The cost to the government was reduced from $1.17 to $0.54, while the earnings of the molder increased from $3.28 to $5.74.

This means one of two things—

1.—Either the operation was so inefficient that anyone could, without difficulty, decrease the working time 62 per cent as in this case cited, or

2.—There must be wonderful possibilities in time study work.

Another Illustration

In one of the large steel foundries located in what is probably the greatest iron and steel center in the country, it was found that the molding time on a certain casting was 147 hours each. Work was studied and time standardized at 85 hours each. The men made the casting in 92 hours each with the following results:

	Per cent.
Decrease in time	32½
Decrease in cost	30
Increase in production	61.1
Increase in earnings of men	12

The shop in question had been operating for a long period of years and its efficiency would compare favorably with the average foundry the writer has been in. The illustration is not an isolated case by any means.

If it is glaring inefficiency which makes it easy to effect these surprising improvements, then why is it that the gains were not made until after time study work began? If work is so easy to better, why defer the betterment? The first conclusion will hardly stand a fair analysis, for all the evidence to date proves conclusively that it is the method of time analysis which discloses what and where the faults are.

As practical foundrymen, who have given years of study to your work, you naturally want to know why this is so. Two years ago in my paper before the American Foundrymen's Association on "The Efficiency Movement in the Foundry," I made the following statement:

"By those who have had the opportunity through actual experience of studying the conditions as they exist, two conclusions have been reached—

1.—That a man can accomplish considerably more than he does.

2.—That the management as business is at present conducted does not know what constitutes the best a man can do."

What is work? In a purely scientific sense it is the merging of men and conditions to form a harmonious arrangement which will produce most efficiently the desired results. The foundry business is sometimes considered a simple proposition, yet when resolved into elements it assumes altogether different proportions. There is the shoveling, ramming, setting gaggers, coring, finishing, closing, pouring and cleaning. There is also the making of cores for the different kinds of work. There is also the metal to be melted and properly poured. The rigging used is an important consideration. There must, therefore, be the proper adjustment of men with these various conditions or results will not be all that is possible.

The chemist, metal specifications, the improvement in cupola practice, the rapid advance in molding machinery, the study of coke problems, transportation facilities and labor saving devices have all combined to materially better the work done in your industry. How about the man side of it all? Has he been studied to the same extent that you have studied the physical forces with which you deal?

There are three factors in the adjustment of men and conditions referred to—

1.—The executive management.

2.—The shop management.

3.—The workmen.

Take the executive management for instance. The manager is usually a very busy man. He must watch the markets so as to purchase his materials to best advantage. He must see to it that his shop is filled with orders at the best prices he can secure. The matter of credits and collecting the money due him must be constantly watched. He must be both a diplomat and a judge to consider and pass upon the complaints from the trade and settle the disputes that arise in his organization. Pushing the work through the shops, watching the quality of the product, studying the costs and statistics furnished him are other matters to which he must give attention. Add to these the other countless details which he must supervise, if not direct, and it is manifestly impossible to expect him to study in a detailed manner, what each man or piece of equipment is doing and whether it is done efficiently or not.

The Shop Manager

The superintendent likewise is a much burdened man. He must maintain a force of men that will turn out what is wanted. There is the assigning of the work to the men; seeing that they are supplied with what they require to enable them to work to advantage. He must set piece rates and adjust wage differences with the men. He naturally is responsible for the melting operations and the quality of the product. Rejections from day to day and the complaints from the trade about errors and poor material or workmanship are other factors to which he must give attention. He must make every effort to make prompt deliveries. If men quit he is forced to fill up the gap as quickly as possible with the best material he can secure. He must advise his men regarding methods of molding, coring and gating. The core room must be supervised. Taking out the work at night and preparing for the next day must also be looked after. Is

*Presented at the Chicago meeting of the American Institute of Metals.

it any wonder, then, in the face of this general description of duties, that the shop manager is unable, regardless of his good intentions, to give to the detailed steps of the various operations, the close study which the securing of maximum efficiency demands? Brought up as I have been in the very atmosphere of the foundry, the point which has surprised me most, is not why a shop management fails to do better, but how it was able to do so well under the conditions which every shop man will recognize as the familiar daily routine.

We now come to the workmen. Even if it were considered as necessary, it would be impossible for a foreman to be with every man for the entire day. Consequently, barring the few general or detailed instructions that a workman gets from his foreman, the real responsibility for turning out a product of good quality in the quickest possible time is really up to the workman. Harassed as the foreman or superintendent usually is with the many details in connection with the daily grind, no other condition could be expected. It is also considered that because a man is hired as a molder and receives the regular rate of wage, he should know his business and therefore shoulder a large share of the responsibility. The molder comes to a plant as a man who has been trained in other shops and because of this very fact his work may be made up of elements of weakness as well as strength. He is expected to make work of good quality, with not too much loss, in a reasonable time. If he can fill this general rather than specific requirements, he stays until he is dissatisfied. If he cannot, he is sent on his way for someone else to try out, which is both costly to the concern and discouraging to the workman.

The training of the men in any one shop is largely the result of doing the work as best they can plus observing what the others do, and the occasional word of advice and instruction from the busy and perhaps overworked foreman. Our workers are not the product of a practical plan of intelligent direction and guidance. An analysis of the records showing the details as to those who are hired, who quit or who are discharged, will reveal a condition in many plants which cannot mean efficiency and which shows conclusively that we are failing to not only supply incentives, but neglecting opportunities in man development. At any rate, the average man as we find him, does not have the time, nor the training, nor the inclination to take the initiative in eliminating faulty conditions and doing all possible in arranging for the proper adjustment of men and conditions. If he did possess these essentials, he would be a foreman—not a workman.

Who then is going to give the proper amount of time and attention to—

1.—The determination and elimination of faulty and unnecessary motion made by the men.

2.—The duplication by all men of the most efficient motions of the best men.

3.—The scientific determination of the best that a man can do day in and day out without injury to his health.

4.—The proper division of responsibility so that the men will not be asked to shoulder any beyond turning out a product of good quality, without delays and annoyances, in the shortest time possible.

5.—The analysis and betterment of all faulty conditions.

6.—Rewarding the men in proportion to the skill and effort of each man.

Table I.
READINGS RECORDED

	A.	B.	C.	D.	E.	F.	G.	H.	Ave.	Best.
					Minutes.					
Ramming drag....	20.6	17.3	22.1	16.5	20.1	14.3	24.7	18.5	19.3	14.3
Ramming cope....	12.4	8.4	14.2	7.1	12.9	10.4	8.5	7.6	10.2	7.1
Finishing	27.3	22.1	28.4	21.7	32.8	23.4	26.5	21.6	25.5	21.6
Setting cores.....	12.7	13.4	15.5	9.6	11.1	8.9	11.4	10.6	11.6	8.9
Total	73.0	61.2	80.2	54.9	76.9	57.0	71.1	58.3	66.6	51.9

The foundry industry is peculiarly one of motions. In a sense it is nothing but motions, and in my estimation is one of the best fields there is today for the application of time and motion study. Analysis reveals a number of variables both as regards the work and the men.

As to the work there are—
Size of unit to be handled.
Weight of unit to be handled.
Position of unit to be handled.
Method of handling.
Time consumed in making motions.
Length of travel.
Position of worker.
Rapidity of motion.
Exertion called for.
Automaticity of motions.
Facilities furnished.

As to the worker there are the following, according to Gilbreth—
Brawn.
Contentment.
Earning power.
Experience.
Fatigue.
Habits.
Health.
Mode of living.
Size.
Skill.
Temperament.
Training.

I have repeatedly called attention to these variables in the worker—

Concentration—Focusing the mind on one thing.

Reason—Ability to draw conclusions.

Interest—Exciting attention in a particular thing.

Judgment—The faculty of reasoning logically.

Energy—Strength and power exerted.

Imitation—The inclination to follow the lead of another.

Imagination—The faculty of forming images in the mind.

Attention—Application of the mind to a particular thing.

Loyalty—Faithful acceptance of a trust.

Memory—Power of retaining and reproducing mental impressions.

Initiative—The power of commencing something without guidance.

Pleasure in work—The faculty of being satisfied with our work.

Considering All Factors

Considering the various classes of motions and the variables in the motions, as against the physical and mental variables of the worker, and it takes more than experience to determine the best attainable standards as to time. A brief study will not do it, for there are too many factors to consider, nor will an analysis of records showing what was done in the past serve as a basis for determining what is a fair day's work. I well remember a case where a molding time of nine hours for two men was set for a piece of work which had previously taken 27 hours for two men. The shop foreman was naturally indignant and the man who standardized the operation was looked upon as not knowing what he was talking about. The molders under the constructive measures introduced, which did not involve the purchase of new equipment nor a change in the method of molding, made the mold the first time in 11 hours, showing that the standard of nine hours was within reason. It was simply a case of new methods of study and waste elimination against the usually accepted way.

Studies are of two kinds—

Time studies in which time is analyzed.

Motion studies in which motions are analyzed, and the use of both can be designated *Timo* studies.

The functions of *Timo* studies are:

1.—Determination of and elimination of waste and inefficiency.

2.—Standardization of
A—Conditions,
B—Operations.

3.—Improvement in the co-operation of production details.

4.—Setting tasks.

5.—Basing rewards for individual efficiency.

6.—Making estimates on work to be made.

7.—Ascertaining costs in advance.

The tools needed in making *Timo* studies are a decimal stop watch with an accumulating control at the side of the winding stem, a small hand counting machine and a clip board on which to place the sheets for entering the facts revealed by the studies.

The method of making and using *Timo* studies is in a general way as follows:

1.—Resolve the work being studied into its various elements and movements.

2.—Secure the elapsed time spent on each element from the stop watch.

3.—List the particulars concerning each element, with the time spent on same, on sheets prepared for the time study.

4.—Note on study all delays, useless motions, faulty conditions and whatever may be found in the way of inefficiency.

5.—Note such delays and interruptions as are unavoidable.

6.—Study for rest and fatigue of the worker.

7.—Note the best element or set of motions on any kind of work for duplication in other lines.

8.—Analyze the facts secured determining the amount of preventable waste in time and ascertaining the proportion of allowed working time to the total time.

9.—From the data compiled standardize the operation as to sequence of elements and prescribe as far as possible the procedure as to the motions.

10.—Set opposite each element or set of motions, an allowed time which will consider rest, fatigue and unavoidable delays.

11.—Analyze the facts concerning waste and inefficiency and outline constructive measures to correct the faults found.

12.—Index the data secured so as to file it with information of like nature.

Timo studies can be classified as follows:

1.—General studies.
2.—Operation studies.
3.—Detailed studies.

The first would be used in cases where you wished to determine the exact molding time of a job. You would start the watch where the work was started, stop the watch for delays and irregularities, using the accumulating stem so as not to set the hand back to zero and start again when work was resumed. Upon completion of the mold, the watch would show the net time spent in actually making the mold. This would not give you, however, any data as to the time taken by each step nor the wastes in any of the steps. Your readings would be about as follows:

	Minutes.
First mold	85.5
Second mold	70.8
Third mold	62.6
Fourth mold	90.7
Fifth mold	50.9
Average	72.1

The second class of studies is much more valuable than the first because more information is obtainable. The work is to be divided into its various logical steps and each step listed on sheets along with the elapsed time for each. These studies can be made in two ways—by listing delays and faults as they are noticed or throwing out all such information and simply recording net actual working time. I prefer the former method, for it is the analysis of such data that indicates the measures necessary to eliminate inefficiency. If the purpose of the study, however, is simply to standardize net working time, the inefficiencies can be eliminated in the readings. There also are three ways of using the watch in connection—snapping the hand back to zero after each reading, or upon completion of each step stopping the watch with the accumulating stem, reading the time and then starting again, or reading the time after each step without stopping the hand. Personally, I prefer the third plan, for in this way no time is lost in stopping and starting the watch. An operator soon learns to read a watch correctly without stopping it.

Your record would look something like this—

	Accumulated time, min.	Net time, min.
1.—Laying board and pattern	3.4	3.4
2.—Placing drag	5.4	2.0
*3.—Getting riddle from another workman	8.4	3.0
4.—Riddling sand	10.9	2.5
5.—Shoveling heap sand	16.1	5.2
6.—Ramming drag	36.7	20.6
7.—Placing bottom board	38.8	2.1
*8.—Looking for clamps	45.0	6.2
9.—Clamping and rolling	50.1	5.1
*10.—Waiting for cope side of pattern to be brought in	59.5	9.4
11.—Placing cope side pattern	60.9	1.4
*12.—Waiting for cope	67.6	6.7
*13.—Waiting for carpenter to cut a bar	75.9	8.3
14.—Placing cope	78.0	2.1
*15.—Looking for gaggers	84.3	6.3
16.—Placing gaggers	88.5	4.2
17.—Ramming cope	100.9	12.4
*18.—Waiting for crane	115.9	15.0
19.—Lifting cope and placing	120.0	4.1
20.—Finishing mold	147.3	27.3
*21.—Waiting for cores	154.6	7.3
*22.—Filing cores	159.3	4.7
23.—Setting and securing cores	172.0	12.7
24.—Closing	179.1	7.1
25.—Clamping and weighting	187.4	8.3
Total time in minutes		187.4
Delays, etc.		66.9
Net working time		120.5

*Delays and wastes.

By making a number of studies as indicated, considerable valuable information would be available for analysis, as will be appreciated by a perusal of the elements listed. The study shows that delays 3-8-15 and 22 are due to faulty conditions, while 10-12-13 and 21 are due to improper planning. Delay 18 can in many cases be considered as unavoidable.

Further analysis would reveal additional information. Assume that the readings had been recorded as shown in Table I.

The best average time is 54.9 minutes at D. The average of all is 66.6 minutes. The best time is 51.9 minutes and using the best average time as a standard, the efficiency is—

$$\frac{54.9}{66.6} = 83.9 \text{ per cent.}$$

Using the best time as standard as against the average time, and the efficiency is—

$$\frac{51.9}{66.6} = 78 \text{ per cent.}$$

A fair standard would be

Ramming drag	17.3	minutes from B.
Ramming cope	8.4	minutes from B.
Finishing	22.1	minutes from B.
Setting cores	11.1	minutes from E.
Total	58.9	minutes

on which basis the efficiency is—

$$\frac{58.9}{66.6} = 88.9 \text{ per cent.}$$

Table II.

A STUDY OF FOUR DIFFERENT OPERATIONS

	1.	2.	3.	4.	5.	6.	Ave.	Best.
A.	20.1	18.7	16.4	24.9	14.3	17.1	18.6	14.3
B.	24.5	27.8	15.3	17.5	20.2	18.9	20.7	15.3
C.	35.2	30.4	37.5	26.4	31.5	29.5	31.7	26.4
D.	10.3	15.4	9.7	8.6	12.5	14.9	11.9	8.6

Determined Fair Standard

This naturally brings up the question—How is a fair standard determined, for it is obvious that the best time should not be used? No absolute law can be developed that will fit every case. The facts in the case plus careful study and good judg-

ment are the governing considerations. It is possible, however, to arrive at an approximation in many cases, which will serve as a valuable indication of what standard to decide upon. In my practice I have used this rule:

A fair standard is approximately one-half the difference between the best time recorded and the average time of the readings, added to the best time or deducted from the average time.

You will note that the standard determined upon in the case just cited was 58.9 minutes. The average time was 66.6 minutes, while the best time was 51.9 minutes. The difference is 14.7 minutes, one-half of which added to the best time equals 59.2 minutes, or nearly the same as the standard of 58.9 minutes.

To carry it a step further, assume that four different operations have been studied six times each, with the results shown in Table II.

Standardizing the time without reference to rule or law and then adding one-half the difference between best and average time to the best time, and the results would be—

	From figures without rule.	Using rule.	Difference.
A.	17.1 at 6	16.4	—.7
B.	18.9 at 6	18.0	—.9
C.	29.5 at 6	29.0	—.5
D.	9.7 at 3	10.2	+.5

In using this rule it should be understood that it applies to standardized operations only, and not to the time study as it is made. In other words, after making a study, eliminating delays, unnecessary motions and everything in the way of inefficiency, the several readings covering a single operation, which as to method is now standardized, will show varying times, the average of which is to serve as the basis for comparison against the best times noted. To illustrate: The time study readings may be 56 minutes, the best and average times 28 and 40 minutes, respectively. The rule would not be—

$0.5\ (56-28)+28=42$ minutes, but
$0.5\ (40-28)+28=34$ minutes.

Standardizing an Operation

Let us standardize the operations from 1-25 previously discussed and determine the efficiency.

	Actual	Standard
1 and 2 placing board, pattern and drag...	5.4	4.7
4 and 5 riddling and shoveling sand.....	7.7	6.0
6 Ramming drag.....	20.6	17.2
7 and 9 placing board, clamping and rolling	7.2	6.1
11 and 14 placing pattern and cope.....	3.5	2.0
16 setting gaggers.....	4.2	2.5
17 ramming cope.....	12.4	9.3
19 and 20 lifting cope and finishing mold.	31.4	24.5
23, 24, 25 setting cores, closing and clamping	28.1	22.7
Total	120.5	95.0
Delays	66.9	
Actual working time...	187.4	
Time waiting for crane	15.0	
Net actual time.....	172.4	
Allowance		9.5
Total standard time....		104.5

The efficiency therefore is—

$$\frac{104.5}{172.4}=60.5 \text{ per cent.}$$

Separation of Inefficiency

Men and management are responsible for inefficiency which, in this case is 100 per cent — 60.5 per cent = 39.5 per cent, and because the delays which amount to 51.9 minutes are due to causes under the control of the management, the net working time chargeable to the molder is 120.5 minutes, so that his efficiency is—

$$\frac{104.5}{120.5}=81.7 \text{ per cent.}$$

Consequently the inefficiency should be distributed as follows:

	Minutes.	Per cent.
Man	16	23.6
Management ...	51.9	76.4
Total	67.9	100.0

You say I am too severe on the management—that the molder should assume some of the responsibility, to the extent at least of seeing to it that he has gaggers and clamps. I know from actual experience that the molder, in many shops, would have his hands full, if he had to see to it that he had what he wanted when he wanted it. Where will you draw the line? If he should look after gaggers and clamps why not expect him to get flasks, sands, patterns and other things? The molder should shoulder the responsibility for making good castings, in the shortest possible time and nothing more. The management should assume the responsibility for enabling the molder to work to the best advantage. Only through this clear cut division can best results be secured. Whether you agree with me as to this, however, is not the question. The important point is that as shown the method of analysis described is a wonderful agency and can be used profitably in any campaign of betterment. We have by no means exhausted the possibilities, however, for there may be inherent defects in the operations which the second method of studying may fail to reveal. So far we have not considered motions to any extent. This is the function of the third class called "detailed" studies.

To illustrate what I mean, sometime ago I studied the making of candy, which is, of course, quite different from making molds in a foundry, but the principles hold in both lines just the same. In watching the girls hand-dipping the centers I was surprised at the rapidity and the coordination of the motion, which were made with such dexterity and swiftness, that the eye could scarcely follow them, and I thought it was going to be by far the most difficult task of time study work I had encountered.

Close study soon revealed the fact, however, that the motions were divisable into certain classes, each class having its own peculiar motions. By starting the watch, when the girl started the motion and stopping it by using the accumulating stem when she finished the motion, then waiting until she started the same motion again and starting the watch, I was able to get a time per 100 motions covering certain kinds of motions. I saw, too, that there was a very definite relation between one motion and another, and by studying a number of girls separately, to determine the peculiar methods followed by each, was able to arrive at some important conclusions. Some girls made 10 motions per piece, others 5. The average was 8.8 motions per piece. Standardizing showed that 7 motions were sufficient and that through proper direction and training 6 motions would do the work as efficiently as 8.8 motions. When I tell you that the girls averaged 83,000 motions per day for 9 hours, you will see how impossible it would have been to study the work in any other way. A study without analysis and the stop watch would have meant practically nothing.

The Ramming Problem

Take ramming for instance. This involves three factors—number of motions, depth and time. Some molders will make many short quick strokes, while others will make fewer and slower but harder strokes. The time may be the same, but there may be a vast difference in the number of motions made. To study this operation it is necessary to measure the depth to ascertain whether one, two or more rammings are necessary. Measure the width and length for area. Start timing and counting the motions made, eliminating delays and interruptions, after which a factor can be determined showing number of rammings per cubic foot or per square foot for varying depths. After a

number of studies have been made an average factor can be arrived at for different classes of work.

Setting gaggers is another example, for on the same work different molders will set a different number of gaggers in varying times. The same kind of study will enable one to determine for different classes of work the number of gaggers to set and the time and motions involved.

Why go to all this trouble? There are three very good reasons why this virgin field, full of enormous possibilities, should be developed through motion study:

First.—In any one shop some men are best at ramming, others most efficient at setting gaggers, still others best at finishing, setting cores, etc. Find the man who is best at any one thing. Study this thing and ascertain just how he does his work. Reduce it to standard practice and then induce the other men to follow as closely as possible the standard way determined upon. Do this with as many of the details as will yield results and the gain will be surprising. All men following in all lines of work the best practice of the best men will mean more to the foundry industry than you have any idea of.

Making More Than One Study

Second.—If a man as to time in ramming is 50 per cent efficient,, and if the number of motions made are twice what they should be, the efficiency of the man is not 50 per cent but 25 per cent, due to the law of dependent sequence. Assuming that a man has rammed a drag in two hours and without eliminating any unnecessary motions increases his efficiency to 100 per cent, it means that the ramming will be done in one hour. Now, if properly directed, he makes only one-half as many motions as he made before, he will ram the drag in one-half hour. The efficiency is therefore—

$$\frac{0.5 \text{ hours}}{2.0 \text{ hours}} = 25 \text{ per cent.}$$

Third.—These studies will reveal many things which are unnecessary. In slicking it will no doubt be found that some molders will use a small tool when a large one would mean much faster work. In nailing, I have many times seen molders placing nails much closer together than the requirements demanded. Cases have also been noticed where too much facing was used.

If the operator becomes skillful, two and even three studies can be made at one time with the same watch. The following will illustrate the plan:

		Man A.		Man B.
Placing board and pattern	2.5	2.5	7.8–10.4	2.6
Placing drag	4.5	2.0	13.0	2.6
Shoveling sand	9.7	5.2	19.0	6.0
Ramming drag	22.0	12.3	32.0	13.0
Rolling	24.0	2.0	34.2	2.2
Placing cope	27.1	3.1	37.0	2.8
Setting gaggers	32.9	5.8	43.1	6.1
Ramming cope	48.1	15.2	61.1	18.0
Total		48.1		53.3

$$61.1 - 7.8 = 53.3$$

Studies can be made by listing the data pertaining to operations and eliminating all delays or by listing delays and wastes noted and eliminating operation details. To get proper ratios, however, the starting and stopping time of observation should be noted from a regular watch, using the stop watch for the time study. If, for instance, a study was begun at 9:15 and finished at 11:25, the elapsed time would be 2:10. If in this time you secured stop watch readings covering the operation details amounting to 1:35 it would mean that there were delays amounting to 35 minutes or 26.9 per cent, and the efficiency would be

$$\frac{95 \text{ minutes}}{130 \text{ minutes}} = 73 \text{ per cent.}$$

It is sometimes convenient to study each element by stopping the watch, reading time, entering information on the sheets and at the same time snapping the hand back to zero for a new reading. When this is done slight errors will creep in and the regular watch should be used as just outlined. For instance, if the study consumed 320 minutes, as shown by the regular watch, and the stop watch reading totals 305 minutes the correcting factor is found as follows:

$$\frac{320\text{-}305}{305} = 4.9 \text{ per cent.}$$

Time Necessary to Make a Study

Many wonder how long a time study should take. This is a question difficult to answer. When starting a study it is next to impossible to determine just what will be unearthed in the way of data and facts. A study may take an hour or it may take several days. It all depends upon the work, the degree of complication and where the points lead to.

Rest and Fatigue

No standard should be determined from a time study without considering the fatigue of the worker and the amount of rest required. If an ultimate attainment is 10 units in a day, it requires greater exertion per unit to go from 9 to 10 units than from 7 to 8 units. Counting normal effort 1, exertion for greater accomplishment is not 1, 2, 3, 4, 5, but rather 1, 2, 4, 8, 16. Yet men are oftentimes criticized for not attaining the 20 per cent from 80 per cent to 100 per cent efficiency as readily and as rapidly as the 20 per cent from 60 per cent to 80 per cent efficiency.

The rule to follow is:

"Any standard determined should be one that a man can attain day in and day out without injury to his health of body and mind."

A Fair Standard

Let me give you a practical example of what I mean. Recently an operation was scheduled at 23 pieces per hour and the worker in a reasonable period was unable to make the schedule. It was decided to study the operation very carefully to determine why the standard could not be attained. The man working as he usually did produced 16 pieces per hour for 5 hours in the morning or 69.5 per cent efficiency. Right after the noon hour I specified a 25-minute working period with five minutes rest, with the result that in the first hour 18 pieces were produced, while in the second 20 pieces were produced. The time then changed to 17 minutes work and three minutes rest, three such periods to the hour and the production rose to 22 pieces per hour. In the fourth hour or the ninth hour after starting time in the morning, the division made was 10 minutes work and two minutes rest and this resulted in 23 pieces per hour. The nature of the work was fatiguing, yet we were able to get 100 per cent efficiency at the end of the day by allowing 16 2/3 per cent rest. Subsequently the average efficiency of the man in question was between 95 and 100 per cent.

A blacksmith would want more rest than a molder, while the molder in turn needs more than a machinist. A man handling pig iron all day would need considerable rest. I often use a 45-minute hour as the working hour, which is equivalent to a rest of 10 per cent.

I am sometimes asked if the stop watch time study is aimed to speed up and drive the men. If I felt for a moment that this was so, I would in the future refuse to use one or have one used for me. In the hands of men with their hearts in the right place the time study is one of the most powerful agencies there is in bringing about greater efficiency.

There are three ways to make a time study.

1.—By keeping the watch in the pocket so as to fool (?) the workman.

2.—Going up to a man and without saying a word flash a watch and begin making notes.

3.—Explaining to the men the purpose

of the study; why the watch is necessary; what it all means; winning their consent and even their interest and approval and then making the study.

The first plan is the rankest kind of deceit and the man who uses this method should not be surprised if the men in turn try to "go him one better." He deserves it.

The second plan is disconcerting to the men; arouses their antagonism and makes them feel that they are mere puppets—to be observed without any right to protest or ascertain the purpose of the study. Only a man lacking tact and with no knowledge of human nature would attempt this sort of a study.

With the stop watch I have studied coal miners, molders, smiths, laborers, machinists, structural workers and men and girls in other lines. I have yet to have my first difficulty because my plan has been:

1.—Getting acquainted with the men.
2.—Explaining the use of the time study and the stop watch.
3.—Securing the confidence of the worker.
4.—Explaining and discussing with the men the details of the work as the study progressed.

Uses of Time Study Data

One of the most important considerations in connection with time study work is the use to which the data can be put in standardizing the various operations, and in discussing this phase I am going to anticipate criticism that while time study work may no doubt be valuable in the foundry working on repetitive work, it would not mean much to the specialty foundry, owing to the large variety of work.

I am willing to admit that if a time study was made covering work that would not repeat for months, the time study would mean little as regards the particular job. In the information it would contain, however, lies its greatest strength.

If you will stop to consider the elements which influence the making of molds, you will find that they are as follows:

A.—The area of the mold.
B.—The depth of the mold.
C.—The class of molding.
D.—The kind of molding.
E.—The pattern.
F.—The core work.

In order therefore to make time study data valuable in every foundry regardless of the class of work, the first step is to classify the various elements as follows:

Green sand.	Bedded.
Dry sand.	Open sand.
Loam.	Chill.
Pit.	

Kind of Molding.

Hand:—	Machine:—
Bench.	Bench.
Light floor.	Light floor.
Medium floor.	Medium floor.
Heavy floor.	Heavy floor.

Pattern.

Construction:—	Shape:—
Simple—A.	Regular—D.
Complicated—B.	Irregular—E.
Extremely intricate—C.	
Kind:—	Mold:—
Wood or metal.	Shallow—F.
Skeleton.	Medium depth—G.
Sweep.	Deep—H.
Core.	

Cores.

Setting:—	Size:—
Simple to set—J.	Small—M.
Difficult to set—K.	Medium—N.
Extremely difficult to set—L.	Large—O.

You can readily see that no matter what conditions may arise, the above classification is sufficient to cover the factors.

Let us first consider the more complicated operations made up of variables, which are:

Shoveling and ramming,
Setting gaggers,
Finishing,
Setting cores,

and then consider each one separately.

The rule to cover this would be:

C = cubical contents of flask.
c = cubical contents of pattern.
F = Factor in hours per cubic foot of sand shoveled and rammed, for various classes of work, to be determined from time studies made.
T = Time for shoveling and ramming.
$T = (C - c) \times F$.

Setting Gaggers

Two rules can be worked up to cover this operation. The first or simple one is:

B = Number of bars in cope.
L = Length of bar in feet.
F = Factor in hours per foot of bar from studies made.
T = Time for setting.
$T = 2(B + 1) \times L \times F$.

The more complicated but more accurate rule would be:

B = Number of bars in cope.
L = Length of bar in inches.
S = Spacing between gaggers in inches.
F = Factor in hours per 100 gaggers.
T = Time for setting gaggers.

$$T = \frac{2(B+1) \times L}{S} \times F$$

Finishing

This is an important part of the molding operations—an element in direct proportion to the degree of complication. Further, finishing is dependent upon the surface to be put into proper shape. Therefore, by using the number of square feet of surface as the basic unit and classifying the varying degrees of complication, a series of standards can be worked up from a wide range of time studies covering various classes of work which, when supplemented by such additional studies as may be necessary, will be approximately correct for all classes of work.

The elements to consider are: Construction of pattern, shape of pattern and depth of mold, and the combinations which can be used are as follows:

1.—A D F	10.—B E F
2.—A D G	11.—B E G
3.—A D H	12.—B E H
4.—A E F	13.—C D F
5.—A E G	14.—C D G
6.—A E H	15.—C D H
7.—B D F	16.—C E F
8.—B D G	17.—C E G
9.—B D H	18.—C E H

(Letters have been taken from Standand Classification.)

The following formula will cover the element of finishing which is to include drawing the pattern:

S = Number of square feet of surface to be finished.
F = Factor per square feet of surface for any standard classification of work covering the combination A D F, which, because it includes the simplest elements, can be considered standard.
A = Allowance in form of a percentage to be added to any combination differing from A D F.
T = Time for finishing.
$(S \times F) + A = T$.

Another formula can be worked up as follows:

S = Number of square feet of surface to be finished.
F = Factor per square foot of surface corersponding to the degree of complication defined in list 1-18.
T = Time for finishing.
$S \times F = T$.

Setting and Securing Cores

This element is dependent upon the number of cores, size of cores and the degree of complication in setting. A number of studies and a standard classification will mean for different classes of work, a formula to cover this factor.

The combinations in this case are:

1.—J M	6.—K O
2.—J N	7.—L M
3.—J O	8.—L N
4.—K M	9.—L O
5.—K N	

The formula is:

H = Number of small cores.
H1 = Number of medium cores.
H2 = Number of large cores.
F = Factor in time per core corresponding to the combination defined at 1-9.
T = Time for cores.

$$\left.\begin{matrix} N \\ N1 \\ N2 \end{matrix}\right\} \times F = T$$

So far we have covered shoveling and ramming, setting gaggers, finishing and setting cores. The factors

(*Continued on page* 195)

New Castings Plant in the Automobile City

Description of Converter Shop of the Detroit Steel Casting Co., Operated in Connection With a Large Open-Hearth Plant

IN ORDER to more properly balance its production, the Detroit Steel Casting Co., Detroit, recently added a converter department to its already extensive facilities for making open-hearth steel castings. The new shop provides equipment for handling automobile work, light railroad work, etc. It is believed that the converter department can be operated in connection with the open-hearth work very satisfactorily and economically, due to the fact that the company already has a strong selling and executive organization. The increase in output will also have a favorable effect on the overhead charges. The new shop voted to molding, the melting equipment being grouped at one end of the shop. A space about 45 feet square in one corner has been set aside for the cleaning department.

The general arrangement of the melting equipment is shown in Fig. 2. It includes a Newten cupola furnished by the Northern Engineering Works, Detroit, a 1-ton Tropenas converter and a Fisher crucible furnace for melting ferro-alloys. The cupola is lined to 28 inches at present, the shell being 42 inches in diameter. As indicated in Fig. 2, this furnace is located in one corner of the shop and the pig iron and scrap are stored nearby in the yard outside. The charging floor in place at the mouth of the converter in Fig. 2. The cupola charges consist entirely of low phosphorus pig iron and a suitable amount of selected steel scrap. The ordinary charges consist of 300 pounds of pig iron, 200 pounds of scrap, 3 pounds of 80 per cent ferro-manganese, and 3 pounds of 50 per cent ferro-silicon. Ordinarily the first five charges contain 5 pounds of ferro-silicon. The cupola metal when analyzed usually shows about 1.71 per cent silicon and 0.50 per cent manganese. The converter metal will analyze 0.22 per cent silicon, 0.71 per cent manganese, 0.045 per cent sulphur and 0.054 per cent phosphorus.

All the sprues from the molding

FIG. 1—MOLDING FLOOR OF CONVERTER FOUNDRY OF DETROIT STEEL CASTING CO.

is in a specially advantageous position because the sprues and return scrap will be utilized in the open-hearth furnaces. This tends to keep the proportions of sulphur and phosphorus in the converter castings at a minimum.

The converter department occupies a wing of the old shop approximately 140 feet long and 113 feet wide. It consists of a main bay, 60 feet wide, surmounted by a monitor, and two side bays each 26½ feet wide. The main bay is served by two 5-ton electric traveling cranes of 30-foot span. Most of the floor area is devoted to molding, which is about 25 feet square is served by an electric elevator. The blast for the cupola is furnished by a Roots blower. A large Roots blower, direct-connected to a 30-horsepower 220-volt Westinghouse motor, furnishes blast for the converter. The motor runs 1,025 revolutions per minute. The blast pressure ordinarily carried in the cupola is 9 ounces, while that in the converter is 3 pounds per square inch.

The metal is handled in a 1-ton bull ladle which is manipulated by the traveling crane. The converter is pre-heated with a torch that burns crude oil. This apparatus is shown floor, together with the spoiled castings are charged into the open-hearth furnaces and, therefore, there is no danger of the sulphur in the steel increasing to excessive proportions. The scrap is loaded into ordinary open-hearth charging boxes in which it is transferred by traveling cranes to the open-hearth foundry. The relatively small quantities of this material melted in the open-hearth furnaces has no appreciable effect on the steel made in the latter department.

The alloys are charged hot into the converter. They are melted in an oil-burning crucible furnace furnished by

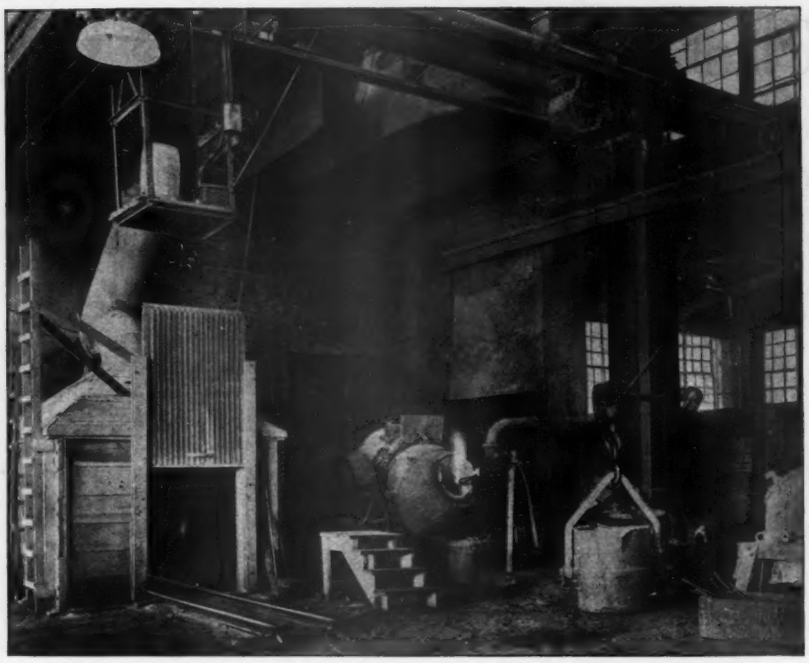


FIG. 2—CUPOLA, CONVERTER AND SAND BLAST HOUSE

Alfred Fisher, Chicago. Although it might be possible to charge them cold, much better results are obtained by pre-melting. For drying the hand ladles, a ten-pot, oil-burning, horizontal ladle heater is provided.

Molding Practice

Owing to the fact that the shop has only been in operation a short time the molding practice has not been thoroughly standardized. The castings are of light weight and most of the work is handled in snap flasks which are molded at the benches shown at the left in Fig. 1. Both steel and wood jackets are used to confine the molds when pouring. The concrete gangway, shown at the extreme right in Fig. 1, is made of a mixture of Portland cement and broken grinding wheels. The edges of the gangway are faced with steel rails. For handling some of the repeat work which the shop will be called upon to do, the air squeezer shown in Fig. 3 was purchased from the Osborn Mfg. Co., Cleveland. Additional machines will be installed as the growth of business requires.

The molding sand is prepared in the mixing department connected with the open-hearth steel foundry, from which it is conveyed in buckets to the converter shop, ready for use. The cores are made in the open-hearth core department.

Most of the work is cast in green sand, but some dry sand work will be handled for which a mold drying oven, 25 feet long, 12 feet wide and 8 feet high, has been provided. It is fired with coke and has no unusual features.

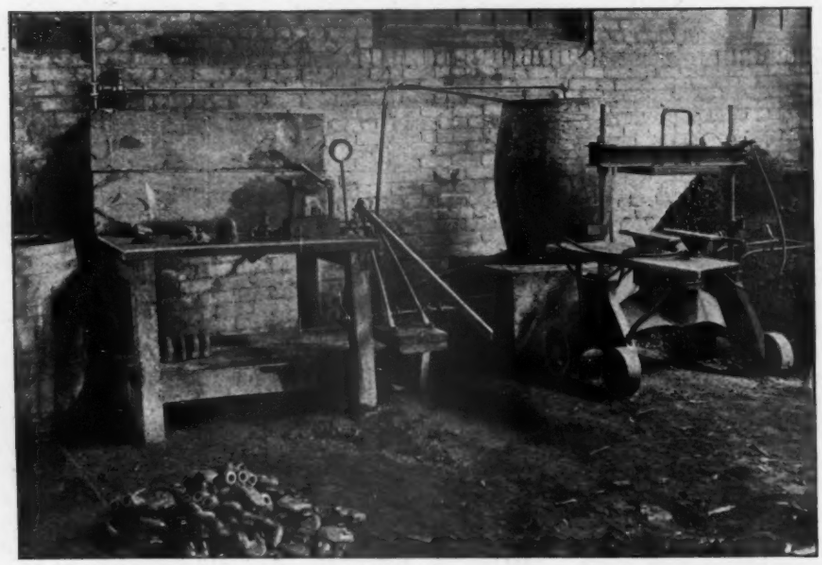


FIG. 3—THE BENCH FOR TESTING PIPE FITTINGS IS LOCATED NEAR THE MOLDING MACHINES

The annealing oven, shown in Fig. 4, was originally designed to burn coal or coke. It has been remodeled to burn oil and to fit the requirements of the converter department. It is 18 feet in length over all and 8½ feet in width. It has been divided into two compartments, one being about 6 feet square, for handling light work, and the other 4½ x 12 feet, for handling heavy castings on a car. Two oil burners are used, and the car compartment is provided with a longitudinal bridge wall to facilitate combustion.

Return bends for steam boiler superheaters are among the standard products of this shop and to insure sound castings they are tested with water pressure to 400 pounds per square inch before shipment. The testing apparatus is shown at the left in Fig. 3. It consists of a force pump connected to a suitable test block to which the bend is secured by means of heavy clamps.

Portable Sand Blast Room

The cleaning department includes a sand blasting apparatus in addition to the ordinary grinding wheels. The sand blast room, which is 10 feet square, is shown at the left in Fig. 2. It is built of wood with a sliding, corrugated steel door. It consists of five sections which are fastened together with twelve bolts and the whole structure may easily be taken down and set up again in another part of the shop. The castings which are sand-blasted are carried on a small car, which runs on a track that extends under the traveling crane runway. A 24-inch exhaust pipe connected to an electrically-driven American blower leads from the roof of the sand blast house and keeps it comparatively free from dust.

The grinding department is shown in Fig. 5. The equipment includes three double emery grinders driven by belts, and five power hack saws manufactured by the Q. M. S. Co. A Toledo sprue cutter is also provided. Accidents in the grinding room are prevented by cast steel hoods which are fitted over each wheel. Each hood consists of three parts, a back and two sides. The latter swing on hinges so that the hood may easily be opened when a new wheel is inserted. When the wheels are in operation, the sides of the hood are held together by through bolts. The metal in the hoods is ¼-inch in thickness. A number of boxes constructed of heavy planks

are placed in front of the grinding stands and the castings are sorted by the workmen as fast as they are cleaned.

The open-hearth department of the Detroit Steel Casting Co. includes two 18-ton stationary acid furnaces, situated in a building 157 feet wide and 103 feet long. The officers of the Detroit Steel Casting Co. include J. S. Newberry, president; S. W. Utley, vice president and general manager; W. S. Allen, secretary, and F. P. Smith, treasurer. The new converter foundry is in charge of E. W. Pike.

Expansion of Cast Iron

By W. J. Keep

Question.—We would like to know why some castings expand more than others? Why do some remain in the expanded state to a greater extent than others, and why do not all stove castings return to their original size when cold? Also we would like to know why some castings burn out more quickly than others? Any information that would help us make cast iron stove fire backs that will have a long life will be appreciated.

Cooling Action

Answer.—Molten iron decreases in size upon cooling. The amount of this contraction depends upon its chemical composition. Gray cast iron is said to shrink about ⅛ inch per foot. If a cold casting were placed in a fire and heated to the melting point, it would expand exactly as much as it contracted during cooling, but if the heating of the casting were stopped at the bright red point and the casting allowed to cool again, it would be larger than it was after its first cooling. If heated and cooled again, or if held at a red heat for a long time, it should be still larger. This elongation can be continued until in some cases it is more than ½ inch per foot. This is due to the heat treatment which enlarges the molecules. In 1895 I conducted a series of experiments along this line and found that ¼ inch pins of Stubbs steel, after repeated heating much below redness, became so enlarged that they would not pass through a ¼ inch hole. A cast iron bar with ¼ inch holes drilled 24 inches apart, heated to redness and cooled, left these openings more than 24¼ inches apart. In my work on "Cast Iron," pages 33 and 63 are contained reports of the annealing over night of a ½ inch square bar 12 inches long, which became permanently expanded 0.065 inch.

Aside from the heat treatment, the chemical composition exerts an influence on elongation because it varies the grain of the iron. Continued heating will change all combined carbon into graphite. Castings in actual contact with an anthracite coal fire will absorb sulphur, thereby ruining the structure of the iron and it will cause cracks and warping. The more graphite and the less combined carbon contained in iron, that is, the softer the metal, the less sulphur will be absorbed. Fire backs made from soft iron of this kind will last longer than if made of iron containing a higher percentage of combined carbon. If an iron for this purpose contains 3 per cent silicon it will give good service.

Malleable iron, white cast iron, or steel scrap will not make good fire backs or grates because mixtures containing this scrap have a high affinity for sulphur and the life of the backs will be destroyed by repeated heating to redness. Soft coal and wood fires also destroy fire backs in another way. By the use of this fuel the heat is not uniform over the entire surface of the fire back. Pitch pine and soft coal will heat one part of the casting white hot, while the other parts are not heated to as high a temperature, resulting in the cracking of the casting. Thus far no one has ascertained by experiment or analysis just what composition of cast iron is the most desirable for fire backs or grate bars.

It would be almost impossible to conduct a series of experiments in

FIG. 4—REMODELED ANNEALING FURNACE

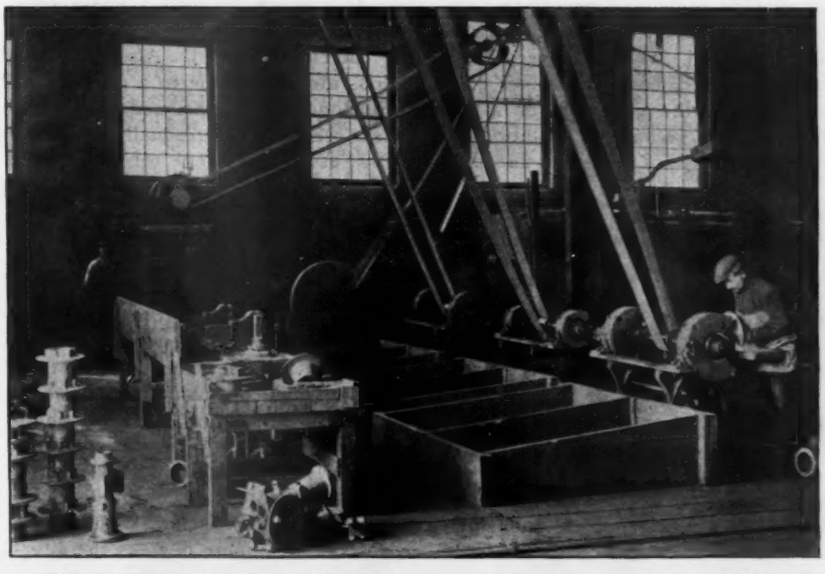


FIG. 5—GRINDING DEPARTMENT, WITH BOXES FOR SORTING CASTINGS

which the conditions would not vary. The heat treatment exerts a far greater influence than any change in chemical composition and for this reason it is apparent that great difficulty would be involved in making such experiments on a uniform basis. Soon after the Baltimore fire A. E. Outerbridge, of Philadelphia, noted that a cast iron door frame had expanded to such an extent that it cracked the stone and brick walls. In addition, vertical iron bars in iron windows were twisted into the form of a letter S as a result of expansion due to heating. Mr. Outerbridge's article giving the results of a large number of experiments along this line is contained in the **Journal** of the American Institute of Mining Engineers, 1905, volume 25, pages 223-244.

The Production of Gold Finishes

By Seymour W Rowsbar

THE number of gold solutions are many and new formulas are suggested to the studious observing plater while operating some particular color. For example, we have a rolled plate surface and desire a rich, yellow gold, but desire to avoid burnishing, so we try a solution composed of phosphate of soda, 12 ounces; C. P. potassium cyanide, ½ ounce; sodium bisulphite, 2 ounces and chloride of gold solution, ½ teaspoonful to 2 gallons of distilled water, and use an anode of platinum with the bath at a temperature of about 160 degrees Fahr. and find we obtain splendid results. Very small proportions of chloride of gold and cyanide are found necessary additions occasionally, and the work is merely flashed. When a very light shade is desired, flash in a silver solution, then in the gold, or for a fine yellow gold, prepare a solution as follows: Reduce 3 dwts. of fine gold to chloride and to one gallon of water add 6 dwts. of C. P. potassium cyanide and 8 ounces sodium phosphate and 1¾ ounces of bisulphate of soda. Heat the solution to 180 degrees and operate with an anode of fine gold. If a light green tint is required, add a few drops of cyanide of silver to a portion of the bath and test for color. Continue additions until the color is obtained. For dark green tints, add gradually a few drops of a solution of arsenic in potassium cyanide to a regular green gold solution. Avoid a surplus, or the gold color will be ruined, likewise the bath. Have a separate rinse water for each gold bath. If a dark brown color is obtained when the deposit forms, remove the article from the solution and rinse, then go over the entire surface with a scratch brush, rinse and return to the solution again and use less current and move the cathode continuously while in the bath. By thus manipulating the article, exact shades may be obtained.

Temperature of the Bath

The fact that the temperature of the bath very materially affects the results must be borne in mind. Variations in temperature may mean variation in current, as with a warm solution the resistance is decreased and the current increased. Also, gold solutions are susceptible to a great variety of conditions occasioned by natural causes which arise gradually and may easily escape the eye of the overconfident operator. These changes have a very pronounced effect upon the character of the film of gold obtained on the cathode.

Experience alone is the best guide when the quantity of free cyanide is considered. Some successful gold platers claim that the free cyanide in a gold bath may be maintained in varying quantities with no particular influence upon the results if the condition is properly considered and the electric current regulated accordingly. No set rules are permissible with regard to voltage or ampere flow, as the altering conditions under which gold solutions are used present a wide range of possibilities as to the use of the current and an observing plater will soon become conversant with the cause and effects as they occur in usual operations. However, it is advisable to carefully prepare the solutions and test them and when satisfactory results are obtained, endeavor to regulate the solution so that the same color may be repeatedly produced regardless of the methods employed by others.

Originate methods to suit your demands, always considering the economical and practical features of the process. If light deposits are justifiable, it is needless to waste metal and time producing heavier deposits. All gold solutions, when in constant use, should be filtered frequently as comparatively small portions of foreign matter present in the bath have a detrimental effect upon the color of the deposit. Naturally, high grade goods admit of extra good work, but from 5 to 10 minutes should be sufficient time to run average work and from 1 minute to 3 minutes for cheaper lines.

Rose gold is produced in various shades and only an expert is capable of identifying some of the daintier tints used on the very best work. A simple rose gold solution consisting of C. P. potassium cyanide, 5 ounces; gold chloride, ½ ounce; caustic potash, ¼ ounce, and 1 gallon of distilled water will, by proper management,

produce a wide range of colors and by manipulating a copper anode in the solution in place of a gold anode, still deeper and darker shades may be obtained. In fact the rose gold finish consists of simply producing a rose tinted surface which in most cases is relieved by high lights of some luster, which is obtained by rubbing bicarbonate of soda on the parts in relief, with the fingers.

Green Gold

A green gold may be produced by using a solution containing silver and proportioned as follows: C. P. potassium cyanide, 1½ ounces; chloride of gold, 60 grains; chloride of silver, 12 grains; C. P. white stick caustic potash, ¼ ounce; sodium phosphate, ½ ounce, and water, 1 gallon. Treat the high lights as mentioned for rose gold. Arsenious oxide is sometimes used in green gold solutions, but its use is attended with considerable risk. If the greatest care is not exercised a very small excess will ruin the solution, but if the correct amount is added, the shades of green are distinctly different than those obtained in a solution containing silver only When such additions are made, use less current than with other green gold solutions. To procure the best tints and most pleasing combinations, a good silver solution and a cyanide copper bath should be accessible, as by either flashing or producing a matte surface, these solutions aid in the production of many beautiful effects.

We have observed that many platers who do not experience serious difficulties in the management of their plating solutions, do have considerable trouble with the cleaning and preparatory solutions. The reason we believe may usually be attributed to lack of attention or rather failure to adapt the preparatory solutions to the line of work to be processed. For instance, a good solution of caustic soda with the possible addition of a small amount of rosin will act satisfactorily on various lines of hardware or stove work, but caustic soda used for cleaning metals before gilding is a bad choice and prepared compounds are being used with splendid success.

The strength of the solution requires some judgment, but for nearly all ordinary lines, 8 ounces of the compound to a gallon of water proves sufficient. If potash is used about the same amount is required and it is advisable to avoid using cleaning solutions of large volume, as small quantities are equally as effective, and when they become very dirty can be thrown away and fresh solutions prepared at very little expense, thus enabling the plater to avoid troubles which are often occasioned by cleaning solutions which are in reality exactly the opposite.

An electric cleaner is an excellent accessory in the plating department for use when cleaning almost any grade of work, but the cleaning tank should be equipped with a change-over switch so that the current may be reversed as desired. Such switches are not sold by all supply houses, but one may easily be made by any person who understands the requirements of the instrument and possesses a moderate amount of mechanical ingenuity. Experts admit that the real secret of the electric cleaner is in the proper use of a reversed current, yet no steps have been taken to supply the trade with a suitable instrument with which to accomplish the change. The European plater obtains better results from the electric cleaner than the average American plater and claims the change-over switch is responsible and such instruments are furnished the trade by several supply firms in Europe.

We must not depend too much upon the supply house to furnish our equipment, for it has been known for years that the plater has not absolute control of the electric current even when using the latest improved resistance boards; yet nothing can be found which indicates even the slightest interest in the matter on the part of the supply firms. It remains for some enterprising plater to originate an idea, perfect the instrument and sell it.

Improvised Rheostats

At present various styles of improvised rheostats are to be seen in service in plating rooms where accurate regulation has been recognized as a necessity. The use of copper and brass solutions, when preparing work for gold plating, is an important item and when the many ways these solutions may be used to assist in obtaining economical results from gold baths are familiarly known, the art of coloring will become less mysterious. Naturally, the first requisite is a reliable copper solution which may be maintained at least expense and produce results which will not eventually ruin the entire finish. If only a small copper bath is required, we would advise the plater to manufacture his own carbonate of copper, as it is a very simple process and if attended with only ordinary care, a pure carbonate will result, while the purchased material is often inferior and to produce proper conditions in the bath made from inferior carbonate, certain additions of sodas are required which with correct conditions would not be necessary. A simple bath of copper carbonate and potassium cyanide will do anything a copper bath should be expected to do and is much easier to operate and maintain than one complicated by several additions of useless chemicals. For rose gold work, a portion of the copper solution may be taken and a small quantity of ammonia water added. This produces a deposit which makes an excellent base for the rose gold shades.

Cyanide Copper Solution

A practical method of preparing a small cyanide copper solution is to fill the tank to be used for the copper bath about two-thirds full of clean (filtered) cold rain water and then dissolve in the water enough C. P. potassium cyanide to alloy 8 ounces of cyanide to each gallon of water in the tank. This can be done by suspending the cyanide, in bags or trays, in the water over night. On the following morning stir in some carbonate of copper by holding the carbonate in a dipper and repeatedly immersing the dipper in the cyanide solution and pouring off the solution only after each immersion. In this manner the carbonate is entirely dissolved and an excess avoided. Carbonate is added and well-stirred in until the color of the solution changes from a green to an amber color, when further additions should cease and a test be made with anodes in position and the bath equipped for work. If the carbonate is of good grade the bath should respond satisfactorily at once.

To prepare the carbonate, take 25 pounds of copper sulphate crystals of best grade and dissolve in as small amount of clean, hot water as possible, but be sure all the sulphate dissolves. Then in another clean vessel dissolve 50 pounds of carbonate of soda crystals using the same care to completely dissolve the soda, and then heat both solutions to the boiling point and at once begin to add the soda solution to the sulphate copper solution in small quantities with constant stirring. Much depends on the size of the vessel containing the copper solution as to the amount of the soda solution which may safely be added at one time. The introduction causes the solution to foam and too much soda would cause a waste of material. Each addition should be followed by vigorous stirring and careful attention should be given the character of the precipitation as the operation progresses. When the effervescence attending the additions ceases, stir well and allow the precipitate to settle, which will require but a few minutes; then siphon-off

the clear solution and throw it away and replace with clean hot water; stir well and allow it to settle again and siphon-off as before. This operation must be repeated several times and constitutes the process of washing the carbonate of copper. When the precipitate is free from soda, which may be determined by tasting the water, it is then washed at least three times with cold water and allowed to settle for at least one hour when the precipitate may be emptied onto a sheet of factory cotton stretched over a wooden frame and allowed to remain until the surplus water is drained off and the carbonate left in a plastic condition. It is then placed in jars or crocks to be kept for future use.

Points to be Watched

The essential points to be watched during the preparation of the carbonate follow: Be sure the copper sulphate is entirely dissolved before adding soda; be careful to add sufficient soda to facilitate complete precipitation, but avoid a surplus and carry out the precipitation with both copper and soda solutions hot, as the carbonate is then of better form and the precipitate settles more readily when washing. By adding carbonate of zinc to the copper solution a brass solution may be prepared and as these baths are generally useful, it is a good policy to prepare them and to use them to assist in the reduction of costs when producing gold finishes. The salt water gold bath is preferred by many men for certain work and in a future article we will discuss this method and some imitation gold solutions which can be used for goods desired a rich yellow, but upon which a deposit of gold would be impractical.

Tropenas Converter Versus Electric Furnace

By G Muntz

IN THE past two years rapid strides have been made in the development of the electric furnace, specially in adapting it for refining metal for small steel castings. Therefore a discussion of the effect of this new melting agency on the Tropenas or side-blow converter process would be particularly pertinent at this time. No one will begrudge the Tropenas process the credit for having put the small steel castings business on a sound basis, and the excellent results obtainable in steel casting production by this method are too well known in the manufacturing world to require extended explanation.

Although steel, as found in channels, I-beams, rails, etc., has almost the same characteristics as steel entering into steel castings, the peculiar conditions inherent to the two manufacturing processes are absolutely different.

As the results that can be obtained by the converter process are well known, it will be necessary only to present the advantages claimed for the electric furnace for manufacturing steel castings. These are as follows:

1.—The metal obtained is lower in phosphorus and sulphur contents than converter steel.

2.—Segregation in electric steel is less than in converter steel.

3.—Starting with cold steel scrap electric steel is cheaper to produce than converter steel.

4.—Absolute uniformity of product.

It is well to define here what is known as the Tropenas or side-blow process. Side-blowing is an old idea, and even Bessemer, in his converter at St. Pancras, was blowing through the metal on the side and near the bottom. Adamson, Clapp, Griffith, Witherow, Walrand Robert, all blew on the side of their converters, but each farther from the bottom. We believe that Tropenas was the first to blow on the surface of the metal, or rather between the slag and the metal. This principle, we think, characterizes the Tropenas process. The Bessemer process and its derivatives afford a means of decarburizing pig iron that approaches the ideal. A converter cannot better be compared than to an oil lamp. As long as the oil is plentiful, the lamp is burning brightly; when the oil gets low, the flame begins to flicker, and when the oil is almost gone the flame drops. In the converter we burn mainly carbon, a flame ensues which will flicker when the fuel is almost gone and will drop when carbon exists only as traces in the final bath. With a converter the signs indicating the end of the operation are unmistakable and the blowing itself is so simple that operators can be trained to be reliable in a very short time. Steel-making, by the converter process, depends mainly on good cupola practice whereby suitable metal is secured for refining in the converter. This feature is a decided advantage and must be taken into careful consideration when comparing the Tropenas process to any other.

Nature of Electric Melting

The electric process, like the open-hearth and other similar methods, entails the use of closed furnaces, in which no outward signs are in evidence when the steel has reached the suitable composition. Test bars must be secured at various intervals and the quality of the steel determined from them by analysis or by direct examination of the fracture.

As compared with the converter, the electric furnace has great advantage; in it can be employed such material as boiler punchings, turnings, borings, etc., which could not be melted in a cupola, meaning that although it is not as efficient a melting furnace as the cupola, it can use cheaper raw material and thereby offset the loss in efficiency to its advantage.

It is well known that while melting in an electric furnace the phosphorus and sulphur contents will not increase, but so far as steel castings are concerned, these two elements are not of capital importance. This, however, cannot be said of the carbon contents of electric steel which are not controlled as easily as in the converter. In the converter, with operations stopped always at the proper time, absolute uniformity is obtained and steels of any carbon contents can be secured at will by the use of suitable additions. The accompanying table of 50 consecutive blows in two Tropenas baby converters shows what can be expected from the pneumatic process.

In the electric furnace, final additions of ferro-manganese and ferro-silicon are made to either obviate oxidation of the metal or to carburize the steel to such an extent as will render it better suitable for the purpose intended, or both. The final product will then contain more carbon than the raw material first used, and inasmuch as at least 35 per cent of the steel poured is returned to the furnace in the form of gates and risers, the carbon contents will keep

on increasing, if delicate refining is not resorted to. However, if the percentage of risers and gates remains about constant, the carbon contents will increase, but only by decreasing increments, and will never go over a certain limit.

Most of the steel foundries today are jobbing shops, and are called upon to produce a great variety of castings, some of which are bulky but of thin section, others bulky and heavy, others small and weighing only a few ounces. To meet the peculiar exigencies of the steel casting business a furnace, therefore, must be flexible and should be able to produce metal of such temperature and in such quantities as will be suitable for any class of castings. Proper temperature can be obtained in both the electric furnace and the converter and either process can produce castings which could not be poured successfully otherwise. Hot metal can be had at no additional cost in the electric furnace.

The electric furnace has the advantage over the converter in permitting the control of the temperature of the metal. This feature is valuable when metal has to be kept in the furnace for some reason or other; once the correct temperature is reached, it can be maintained at slight additional expense.

Capacity

Metal can be held in the converter, but not indefinitely as in the electric furnace. Therefore, the electric furnace is limited in capacity to its own charge. In other words, a 2-ton electric furnace will produce 2 tons of steel every 2½ or 3 hours.

If we compare this to what can be done in a converter of equal charge capacity we find that from two to three operations can be made per hour, thereby allowing the accumulation of from four to six tons of steel per hour. We recall the instance of an 18,000-pound casting being poured successfully with a single two-ton converter. Six blows were made to secure sufficient metal, each blow being poured on top of the other in a ladle; it took one hour and 45 minutes to make the steel and after the casting was poured there was not even a skull left in the ladle. This shows that even after waiting almost two hours, the steel was still very hot.

The various impurities which are found in steel have different freezing points, and show a tendency to segregate and concentrate in certain portions of large bodies of cooling metal.

This segregation is affected by various factors such as initial temperature of the molten mass and especially the rate of cooling. From experiments made by Talbot in 1905 it was concluded that sulphur segregates most, phosphorus next, then carbon and finally manganese. It was found also that the usual additions of aluminum reduced the segregation considerably. Authorities differ as to the elements which segregate first, and Professor Howe shows that carbon segregates the most readily. It, therefore, is interesting to apply either results to the particular case on hand.

The field covered today by the converter and the electric furnace is such that metal manufactured by either process freezes almost instantly after being poured. Small and medium steel castings offer numerous surfaces of cooling, and even if the steel produced by the converter process contains more sulphur and phosphorus than electric steel, segregation will take place only in negligible quantities as the rate of cooling is too great to allow any extensive concentration.

It is well known that with sulphur contents up to 0.1 per cent the direct action on ductility and tensile strength is negligible. The only detrimental affects of sulphur is to cause red shortness, or cracking and checking if the steel has to be forged or rolled.

Neither the converter nor the electric furnace contemplate, to any great extent, the manufacture of steel castings which will later be forged. It ensues that higher sulphur contents in converter steel would not prove detrimental to steel castings especially if the manganese contents are properly graduated to offset any possible bad effect due to sulphur.

The only advantage of very low sulphur, therefore, seems to apply to the rare case of steel castings which have to withstand high temperature.

Phosphorus is the element which is the most detrimental to steel as it creates brittleness under shock and general cold shortness. It is the concensus of opinion that phosphorus contents should not exceed 0.08 per cent for all practical purposes. Between 0.05 and 0.1 per cent the elongation and reduction of area are not affected to any great extent while the

TESTS FROM TWO TROPENAS BABY CONVERTERS BLOWING ALTERNATELY

Cast No.	Silicon, per cent.	Phosphorus, per cent.	Sulphur, per cent.	Carbon, per cent.	Cast No.	Silicon, per cent.	Phosphorus, per cent.	Sulphur, per cent.	Carbon, per cent.
11447	0.26	0.050	0.048	0.220	11489	0.23	0.048	0.040	0.208
11448	0.27	0.055	0.047	0.225	11490	0.23	0.046	0.049	0.244
11449	0.26	0.045	0.046	0.208	11491	0.23	0.048	0.048	0.220
11450	0.28	0.048	0.050	0.215	11492	0.25	0.048	0.049	0.215
11451	0.29	0.050	0.048	0.220	11493	0.23	0.050	0.047	0.228
11452	0.26	0.056	0.054	0.214	11494	0.24	0.046	0.047	0.217
11453	0.30	0.048	0.046	0.218	11495	0.31	0.045	0.050	0.220
11454	0.26	0.050	0.046	0.218	11496	0.32	0.050	0.054	0.212
11455	0.27	0.056	0.048	0.224	11497	0.28	0.050	0.050	0.206
11456	0.28	0.060	0.053	0.240	11498	0.32	0.046	0.048	0.210
11457	0.30	0.054	0.048	0.228	11499	0.33	0.048	0.049	0.212
11458	0.28	0.050	0.046	0.214	11500	0.31	0.046	0.047	0.210
11459	0.28	0.060	0.056	0.200	11501	0.31	0.047	0.047	0.210
11460	0.27	0.050	0.051	0.228	11502	0.27	0.050	0.054	0.227
11461	0.31	0.056	0.050	0.215	11503	0.27	0.055	0.049	0.190
11402	0.28	0.055	0.047	0.200	11504	0.27	0.055	0.049	0.190
11463	0.27	0.050	0.046	0.204	11505	0.23	0.048	0.045	0.218
11464	0.26	0.098	0.044	0.202	11506	0.26	0.040	0.045	0.218
11465	0.28	0.050	0.044	0.210	11507	0.25	0.043	0.049	0.198
11466	0.27	0.055	0.050	0.224	11508	0.25	0.043	0.049	0.190
11467	0.27	0.058	0.052	0.216	11509	0.26	0.043	0.045	0.215
11468	0.30	0.050	0.048	0.220	11510	0.27	0.044	0.044	0.230
11469	0.31	0.050	0.044	0.215	11511	0.30	0.044	0.043	0.238
11470	0.30	0.056	0.049	0.214	11512	0.28	0.045	0.046	0.206
11471	0.31	0.048	0.045	0.198	11513	0.28	0.045	0.046	0.206
11472	0.30	0.050	0.045	0.217	11514	0.32	0.045	0.045	0.205
11473	0.32	0.050	0.047	0.200	11515	0.30	0.045	0.050	0.238
11474	0.25	0.054	0.045	0.228	11516	0.27	0.044	0.046	0.238
11475	0.25	0.054	0.048	0.198	11517	0.25	0.042	0.045	0.217
11476	0.20	0.051	0.045	0.210	11518	0.26	0.042	0.045	0.230
11477	0.27	0.053	0.049	0.196	11519	0.23	0.042	0.045	0.232
11478	0.29	0.050	0.044	0.214	11520	0.30	0.042	0.053	0.237
11479	0.30	0.060	0.053	0.202	11521	0.31	0.046	0.049	0.212
11480	0.31	0.058	0.050	0.196	11522	0.30	0.046	0.049	0.212
11481	0.25	0.064	0.051	0.190	11523	0.31	0.046	0.049	0.225
11482	0.28	0.055	0.052	0.195	11524	0.29	0.045	0.050	0.208
11483	0.27	0.051	0.049	0.194	11525	0.28	0.045	0.050	0.223
11484	0.30	0.050	0.045	0.226	11526	0.27	0.050	0.055	0.206
11485	0.33	0.050	0.048	0.216	11527	0.26	0.054	0.046	0.220
11486	0.30	0.048	0.044	0.200	11528	0.26	0.053	0.053	0.238
11487	0.27	0.046	0.042	0.224	11529	0.28	0.052	0.054	0.202
11488	0.26	0.048	0.042	0.192	11530	0.26	0.056	0.049	0.226

Average manganese, 0.80 to 0.90 per cent. Variations in analysis are due to different weights of metal blown without altering weights of final additions. Average weight of blow, about one ton; average time of blow, 12 minutes.
Tests made by Michigan Steel Casting Co., Detroit.

tensile strength increases. The readings of the testing machine are not, therefore, of any special value when the effects of phosphorus are considered. Cold bending tests, by use of a drop, are best suited to determine the quality of steel castings, but in the case of phosphorus we find results erratic and capricious and it seems that on this score the best factor to be considered after chemical analysis is the reliability of the producers of the steel.

In the present discussion, it must be admitted that the electric furnace has the advantage of being able to use such raw material as will insure low phosphorus content, but accumulation of phosphorus is very slow in the converter process and the chances of picking it up from fuel while melting are remote. It, therefore, is just to say that converter steel, while higher in phosphorus content than electric steel, more than comes within the ordinary limits of safety.

From the Seat of the War in Mexico

(Written Before Torreon Was Taken by the Rebels)

By H H Miller

IN THE accompanying illustrations are shown patterns and castings, which under ordinary conditions would have been made of iron, but since all of the iron foundries in Mexico are closed, are now being made of brass. Owing to the complete demoralization of business in this part of the country, the owners of iron foundries and machine shops were compelled to close their plants several months ago and leave for the United States. It is only owing to the fact that I have a small shop at Torreon and a very light overhead that I have been able to continue operations and to fire a furnace occasionally for orders that are received with a not too great frequency. The mines, smelters and mills are practically all closed and only the ranches and large plantations are having foundry and machine work done. Pieces are ordered only when old sections are broken or are entirely worn out and must be replaced to keep the gins and other machinery in operation until they can finish ginning last year's cotton crop.

When the planters find that they cannot get what they want in iron and learn that I can make it in brass, they do not hesitate to place their orders with me and pay cash for the work without kicking about the price. There is only a small number of molders and other mechanics available. When the other shops were closed a large number left to seek work in other parts of the country. Subsequently, when the revolutionists came into Torreon they took possession of some of the foundries and shops and pressed all of the available mechanics into service repairing guns and cannons and for making ammunition. However, the mechanics did not think it safe to stay if the federals returned, and all left when the rebels were driven out by the government forces. After the smoke cleared I got an order for brass castings and started out to round up a gang. I succeeded in locating one molder, two helpers, a patternmaker and a machinist.

As I have no machine shop, I concluded to have the work done in one of the shops which had been used by the revolutionists. However, I found that practically all of the machinery had been rendered useless and would have to be completely overhauled before it could be used again. Then the manager of the Continental Mexican Rubber Co. granted me permission to put a machinist at work in its private shop, and this enables me to take care of my orders.

There are two general foundries and machine shops in Torreon, and these, with my brass foundry, in ordinary times employ 200 men. At the present time all of the foundry and machine work that is sent to Torreon comes to my shop and I have to take care of this work with one patternmaker, one molder and two helpers, working three or four days a week. One machinist in a borrowed shop, working about four days a week, keeps up with the machine work.

Can you realize from the foregoing what three years of revolution has done for one of the richest mining and agricultural districts in the world?

In the accompanying illustrations the patterns and castings shown follow: Fig. 1, runner for centrifugal pump, weight, 60 pounds; 2, runner for a centrifugal pump, weight 88 pounds; 3, gear for an old-style cotton press, weight 154 pounds; 4, pinion for gear 3, weight 38 pounds; 5, piece for a threshing machine, weight, 40 pounds. This latter casting, containing seven elbows, was molded from the old broken section, which was made of iron.

In Fig. 2 are shown patterns for castings formerly made of iron, but which now are made of brass; 6, is a bushing for making packing rings and weighs 85 pounds; 7 is a corner guide for a gin press, four of them forming a set weighing 203 pounds; 8 is a pinion, weighing 40 pounds; 10, head for an hydraulic gin press, weight, 462 pounds, and 11, threshing machine casting, weight, 45 pounds. This shows the old casting which was used as a pattern.

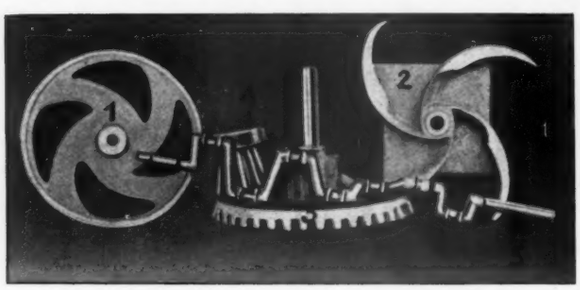


FIG. 1—BRASS CASTINGS MADE IN A FOUNDRY AT TORREON, MEXICO

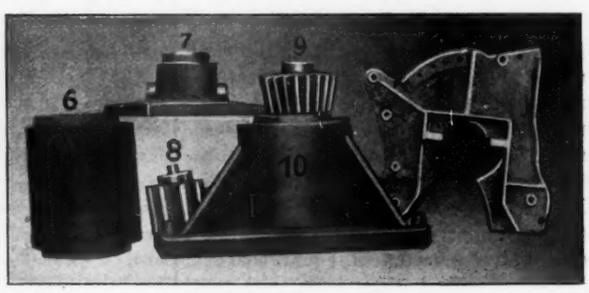


FIG. 2—PATTERNS FOR CASTINGS NOW MADE IN A MEXICAN FOUNDRY

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

BOARD FEET IN PATTERN LUMBER

By A. W. Nock

The seven tables published in Data Sheets Nos. 159 to 162, inclusive, cover a complete range of sizes of lumber ordinarily used in making wood patterns. The first table in Data Sheet No. 159, published in the April issue of THE FOUNDRY, covers boards 1 inch thick, ranging from 1 to 12 inches in width and from 4 to 16 feet in length, the widths advancing by single inches and the lengths by feet. The second table in the same Data Sheet covers boards 1¼ inches thick, also ranging in width and length from 1 to 12 inches and from 4 to 16 feet. In a similar manner, the subsequent tables cover 1½-inch, 2-inch, 2½-inch, 3-inch and 4-inch planks.

The number of board feet in planks of odd length, not given in the table, may be found by simple interpolation. For instance, to find the board feet in a plank 1½ inches thick, 5 inches wide and 10 feet 3 inches long, we first turn to the 1½-inch table in Data Sheet No. 160. On the line opposite 1½ x 5, under 10 feet, we find 6.18 board feet and under 11 feet, 6.75 board feet. The difference is 0.57 board feet. Now 10 feet 3 inches is equivalent to 10¼ feet. Therefore, divide 0.57 by 4 and add the product, 0.142, to 6.18, giving 6.322 board feet in a plank 1½ x 5 x 10.

If neither the width nor the length is given exactly in the table, a double interpolation is necessary; and if extreme accuracy is desired, a triple interpolation may be required if the exact thickness is not in the table.

Size.	Length in Feet. 4	5	6	7	8	9	10	11	12	13	14	15	16
	Feet Board Measure.												
2½ x 1	0.82	1.08	1.25	1.50	1.66	1.88	2.08	2.25	2.5	2.75	2.88	3.16	3.33
2½ x 2	1.66	2.08	2.50	2.88	3.33	3.75	4.16	4.56	5.0	5.40	5.80	6.25	6.66
2½ x 3	2.50	3.25	3.75	4.38	5.00	5.63	6.25	6.88	7.5	8.25	8.75	9.38	10.00
2½ x 4	3.33	4.16	5.00	5.80	7.50	8.00	8.33	9.16	10.0	10.80	11.66	12.50	13.33
2½ x 5	4.08	5.25	6.25	7.33	8.33	9.40	10.40	11.50	12.5	13.56	14.56	15.66	16.66
2½ x 6	5.00	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.0	16.25	17.50	18.75	20.00
2½ x 7	5.80	7.33	8.75	10.16	11.66	13.16	15.00	16.08	17.5	18.75	20.40	21.88	23.33
2½ x 8	6.66	8.33	10.00	11.66	13.33	15.00	16.66	18.33	20.0	21.66	23.33	25.00	26.66
2½ x 9	7.50	9.40	11.25	13.16	15.00	16.88	18.75	20.66	22.5	24.33	26.25	28.08	30.00
2½ x 10	8.33	10.40	12.50	14.56	16.66	18.75	20.80	23.08	25.0	27.08	29.16	31.25	33.33
2½ x 11	9.16	11.50	13.75	16.08	18.33	20.66	23.00	25.25	27.5	29.82	32.16	34.50	36.66
2½ x 12	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.0	32.50	35.00	37.50	40.00

BOARD FEET IN PATTERN LUMBER

By A. W. Nock

The tables should be used with judgment. That is, do not take the trouble to make a lengthy interpolation, when the accuracy of the final result, in money, would not be changed over one cent. In most cases sufficient accuracy is attained by taking the nearest even dimensions given in the table without further calculation.

Size.	Length in Feet. 4	5	6	7	8	9	10	11	12	13	14	15	16
	Feet Board Measure.												
3 x 1	1.0	1.25	1.5	1.75	2.0	2.25	2.5	2.75	3.0	3.25	3.5	3.75	4.0
3 x 2	2.0	2.50	3.0	3.50	4.0	4.50	5.0	5.50	6.0	6.50	7.0	7.50	8.0
3 x 3	3.0	3.75	4.5	5.25	6.0	6.75	7.5	8.25	9.0	9.75	10.5	11.25	12.0
3 x 4	4.0	5.00	6.0	7.00	8.0	9.00	10.0	11.00	12.0	13.00	14.0	15.00	16.0
3 x 5	5.0	6.25	7.5	8.75	10.0	11.25	12.5	13.75	15.0	16.25	17.5	18.75	20.0
3 x 6	6.0	7.50	9.0	10.50	12.0	13.50	15.0	16.50	18.0	19.50	21.0	22.50	24.0
3 x 7	7.0	8.75	10.5	12.25	14.0	15.75	17.5	19.25	21.0	22.75	24.5	26.25	28.0
3 x 8	8.0	10.00	12.0	14.00	16.0	18.00	20.0	22.00	24.0	26.00	28.0	30.00	32.0
3 x 9	9.0	11.25	13.5	15.75	18.0	20.25	22.5	24.75	27.0	29.25	31.5	33.25	36.0
3 x 10	10.0	12.50	15.0	17.50	20.0	22.50	25.0	27.50	30.0	32.50	35.0	37.50	40.0
3 x 11	11.0	13.75	16.5	20.25	22.0	24.75	27.5	30.25	33.0	35.75	38.5	41.25	44.0
3 x 12	12.0	15.00	18.0	21.00	24.0	27.00	30.0	33.00	36.0	39.00	42.0	45.00	48.0

Size.	Length in Feet. 4	5	6	7	8	9	10	11	12	13	14	15	16
	Feet Board Measure.												
4 x 1	1.33	1.66	2.0	2.33	2.66	3.0	3.33	3.66	4.0	4.33	4.66	5.0	5.33
4 x 2	2.66	3.33	4.0	4.66	5.33	6.0	6.66	7.33	8.0	8.66	9.33	10.0	10.66
4 x 3	4.00	5.00	6.0	7.00	8.00	9.0	10.00	11.00	12.0	13.00	14.00	15.0	16.00
4 x 4	5.33	6.66	8.0	9.33	10.66	12.0	13.33	14.66	16.0	17.33	18.66	20.0	21.33
4 x 5	6.66	8.33	10.0	11.66	13.33	15.0	16.66	18.33	20.0	21.66	23.33	25.0	26.66
4 x 6	8.00	10.00	12.0	14.00	16.00	18.0	20.00	22.00	24.0	26.00	28.00	30.0	32.00
4 x 7	9.33	11.66	14.0	16.33	18.66	21.0	23.33	25.66	28.0	30.33	32.66	35.0	37.33
4 x 8	10.66	13.33	16.0	18.66	21.33	24.0	26.66	29.33	32.0	34.66	37.33	40.0	42.66
4 x 9	12.00	15.00	18.0	21.00	24.00	27.0	30.00	33.00	36.0	39.00	42.00	45.0	48.00
4 x 10	13.33	16.66	20.0	23.33	26.66	30.0	33.33	36.66	40.0	43.33	46.66	50.0	53.33
4 x 11	14.66	18.33	22.0	25.66	29.33	33.0	36.66	40.33	44.0	47.66	51.33	55.0	58.66
4 x 12	16.00	20.00	24.0	28.00	32.00	36.0	40.00	44.00	48.0	52.00	56.00	60.0	64.00

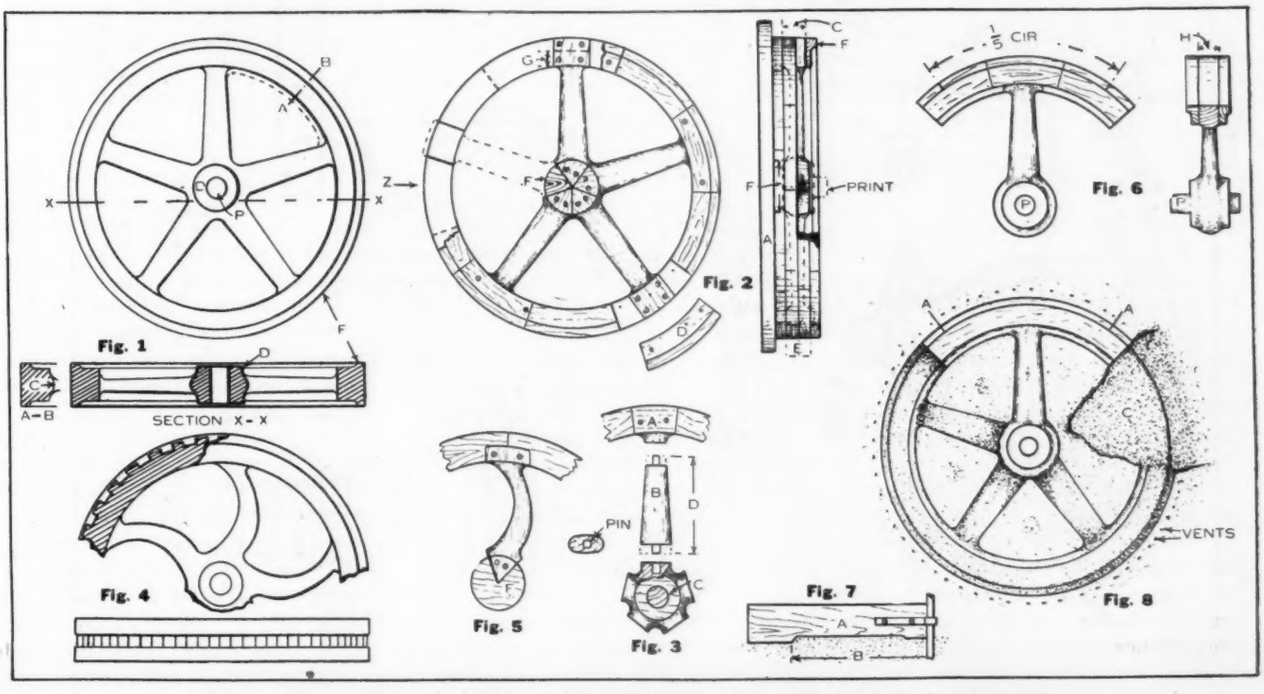
Making, Molding and Casting Large Fly Wheels

Detailed Instructions for Making Patterns, Sweeps, Cores and Molds for Fly Wheels of Various Shapes and Sizes

By B Gordon

OWING to the simplicity of their design—which permits of only slight variation in character — flywheel castings of the heavy rim type are considered comparatively easy jobs. Furthermore, owing to this simplicity in design, the methods practiced for their production must consequently be confined within narrow limits. As a matter of fact, these ideas are erroneous and for an apparently *simple* job it is remarkable that they should give rise to so many divergent opinions. The question of economy, of course, is one of the chief factors to be considered by both the foundryman and patternmaker, for whatever method is evolved, relative costs of both departments, with the compensating advantages to be derived from any given method, have to be thoroughly considered. In these respects the governing factors are the number of castings required for a given order, if of a standard character, size and if they are required full, or in part. With reference to the latter, some types of flywheels are made in sections, and the completed wheel is assembled by means of bolts, shrink rings, pins, cotters, etc.

To explain some of the various methods practiced, Fig. 1 gives a common example of heavy rim flywheel, with straight arms, the latter being elliptical in section. When of a standard character, or the initial order is large, the usual practice is to form a full pattern which, if the depth of rim be excessive, is split centrally through the rim only, thereby obtaining an easier cope lift, the upper divided portion of the pattern rim being carried and lifted in the top part, being removed as a separate unit. Obviously, this method reduces considerably the making of a mold incidental to a heavy top lift when fractures are to be expected. The arms, as a general rule, are not split or divided when their sectional form is elliptical as this formation tends to give a free, easy lift. As this arm section, that is, elliptical, is the most common and efficient, other sectional arm forms, owing to their rarity, are not considered in the present article. The rim of the pattern for the example cited is built of segments, the number and thickness of the course depending upon the diameter and depth, full consideration being given to the principle of all segmental construction that the greater number of courses, the greater the strength obtainable. The split joint is obtained by gluing further segments which form the other part of the joint upon it, this afterward being split apart. This method is sufficiently strong to allow of turning without the aid of screws or nails. The arms are, in the majority of cases, worked up as single units and are prepared to shape previous to building up the rim so that their position is allocated during the make-up of this latter and they can be built into (Fig. 2) or through the rim and form a definite portion of it, thus obtaining stability, rigidity and accuracy with economical working. This will be readily understood if the rim portion were made up definitely to shape, seating for the arms reception having to be cut afterwards, which would entail considerable labor with questionable accuracy. As will be noted from Fig. 2, which shows the pattern's construction at this stage, the joint angles of the arms, where they abut against each other at the hub, are obtained



FIGS. 1 TO 8—METHODS OF MOLDING STRAIGHT AND CURVED ARM FLYWHEELS

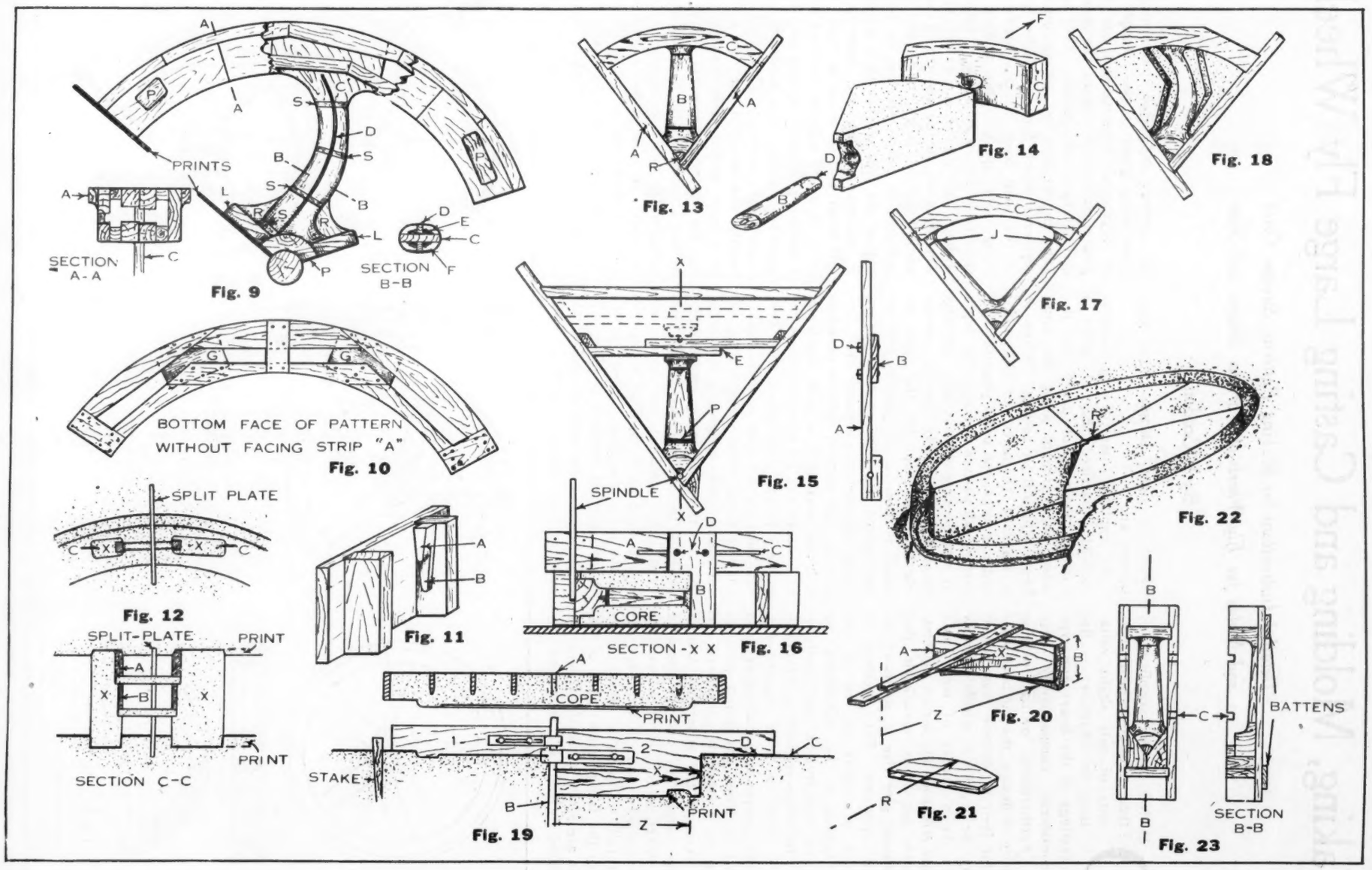


Fig. 9 Fig. 10 Fig. 11 Fig. 12 Fig. 13 Fig. 14 Fig. 15 Fig. 16 Fig. 17 Fig. 18 Fig. 19 Fig. 20 Fig. 21 Fig. 22 Fig. 23

FIGS. 9 TO 23—CORE BOXES AND CORES AND METHODS OF MAKING FLYWHEEL MOLDS BY THE USE OF STRIKES

from, and depend upon, their number an equal corresponding angle being given to each. The root—that portion in conjunction with the hub—and tip of the arm, is invariably worked to contain its own fillets if the work involved is not excessive as greater uniformity of line can be obtained with added strength, this being as distinct from a made-up fillet of wax, plaster, putty, or any other of the pattern-makers "friends."

If the arm length between the fillets of tip and root be considerable, the practice is to form the straight portion as a separate part, this method allowing for quicker production by the use of the plane. The arm is fitted into the rim by means of pins, spigots, or dowels, which are formed usually from the arm. The latter is cut down to form the dowel or pin. In Fig. 3, *D* is the excess length, *B* being the required arm length, and *C* is the fully worked hub which receives the arm spigots at the root position. For the arm tip fillets which are in conjunction with the rim, a piece, *A*, is worked up and bedded-in as shown. It is the exception rather than the rule to check the arms, one into the other, as it restricts the working facilities, is weaker when the number of arms is more than four, and is also more costly produce.

Supports

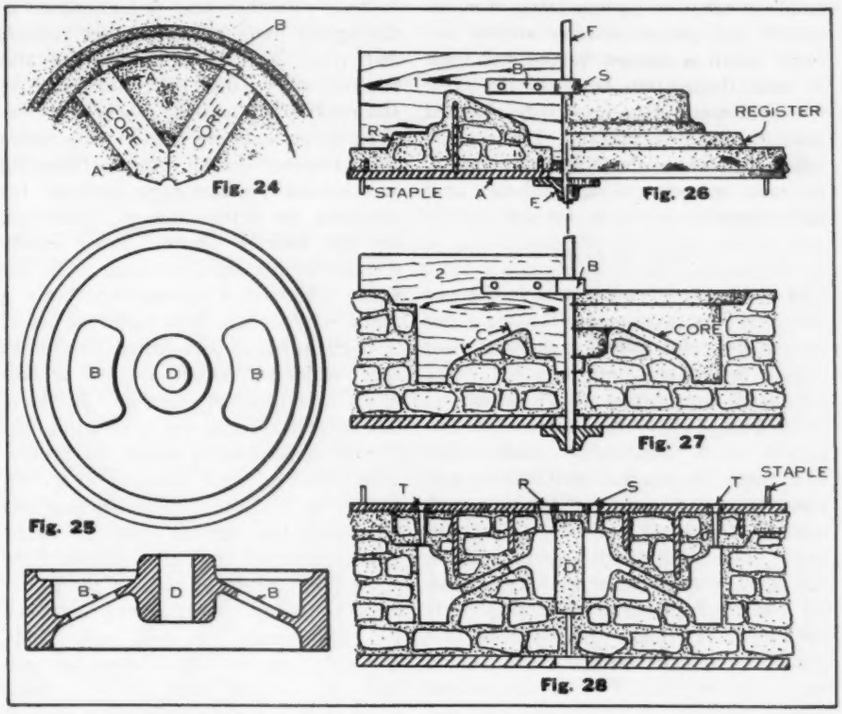
To give underneath support to the arms during turning operations a boss, *F*, Fig. 2, is attached to the face plate, *A*, this boss support being converted into the hub boss, *D*, Fig. 1, when the fully built-up wheel is chucked for turning the opposite side. To avoid further edges as far as possible, incidental to attached fillets, the latter, in every case, are worked from the solid material, and as will be noted in Fig. 2, the facing strip, *F*, Fig. 1, is formed out of the top layer of segments. For the central hole, *P*, Fig. 1, prints are required on both sides, the cope side being of a lesser thickness with a quick taper to give every lift facility. If the wheel be of a diameter less than 2 feet and of narrow rim, it is sometimes more expedient to build-up the rim, which is not required split and to build-in the arms as shown in Fig. 2. In these cases the segments, *D*, which cover those positions covering the portions where the arms are required are not glued in the first instance, but screwed so that they are easily detached to allow of the reception of the arms. This method also is frequently adopted when the work is of the hurry-up order, it then being simple to distribute the work to facilitate production.

The methods that are applicable to the straight arm, full pattern flywheel also are applied when the wheel arms are of the curved type, as shown in Fig. 4. The arms at the hub are affixed in precisely the same manner, but at the arm tip, building-in (Fig. 5), as distinct from building-through the rim is the usual practice when the curvature produces at this position short grain which, when built-in is unaffected by ramming or rapping. Fig. 4, also shows around its periphery a form of barring gear which is required for setting the crank shaft into position. As this form of gear is standard—it being applied to all the heavier wheels—its application is also extended to the straight arm and is cored out by means of cores which contain, when they are placed into position, the required number of teeth. When this is required a print for carrying these cores is obviously necessary and this is made from the segments occupying the required position around the wheel. For example, the segments giving the distance *C*, Fig. 2, would be made to extend beyond the periphery of the wheel to form a print, *E*.

Owing to their expense, full patterns are the exception, although they tend to facilitate foundry production more than any other method; but as their initial cost is great, to be an economical advantage, the number required from its uses must be sufficient to give compensating advantages.

When the order is small, a common method often adopted for making the mold in green sand is to utilize a part pattern, the part pattern containing one arm with a portion of the rim. Assuming the wheel, Fig. 1, to be made by this method, the pattern would be built as shown in Fig. 6, where it will be noted that the rim portion is in excess of one-fifth the circumference, which distance, one-fifth circumference—or the required circumferential part—is put upon the rim as a guide for its mold position.

The pattern may be formed as indicated, but this method is obviously not arbitrary as the size must regulate the most convenient method, both from the viewpoint of economizing labor and material. In this example, the excess flywheel weight internally (Fig. 1, section *A-B* at *C*) is given and this excess is usually made by the central segments being of the same thickness as the material at the arm tip, *H*, Fig. 6. This method allows the arm to be placed into position without cutting away the rim to receive it and as strength is not the chief consideration in this case, thick segments are the most economical to use for the patterns construction. Prints are placed upon both sides of the hub, the drag side having a print, *P*, greatly in excess, as regards length, to that required for the cope side, this being apparent when it is considered that the drag print has also to act as the rotator. For molding from such a pattern part a board, *A*, Fig. 7, is supplied, which is cut to the shape of the boss and rim face. This is attached to a spindle placed in the floor and over a prepared and rammed bed is made to sweep away



FIGS. 24 TO 28—MOLDING LARGE FLYWHEELS AND THOSE OF THE PLATE TYPE

the mold, giving the rim face and boss impression.

During the sweeping-up process care must be exercised to obtain a level bed by means of a spirit level placed upon the mold surfaces, the board being made to adapt itself to obtain this. The board and spindle are next removed and the pattern part placed into position is rammed up to the rim level outwardly and jointed centrally along the arms. A flask is next staked-over the pattern, being large enough to contain the full diameter of the wheel and this flask, at the position covering the pattern, is rammed, gaggers being used plentifully to prevent a drop-out. The flask is then lifted off and the pattern marks *A-A*, Fig. 9, which give the definite circumerential distance, are marked upon the mold surface, the pattern being then removed and placed into its second position which is defined by the one mark *A* upon the pattern being in line with the mold mark *A* as previously obtained from the molded pattern. The cope is again placed over the drag and rammed, the same procedure being continued until the completed wheel is formed.

Small Wheels

In the cases of small wheels the entire cope box is rammed, the mold being cut away for ramming the part contiguous to that previously molded. Vents are made around the mold's periphery, being pierced with the wire while the pattern is in position at each stage. The vents are carried well down, and afterwards are connected together and led off at various positions across the joint. Fig. 8 gives the plan view of this mold with three arms finished and the pattern in position at another part, leaving the remaining part, *C*, to be fully molded up. Referring to the use of the board, *A*, Fig. 7, by its use underneath, ramming up is avoided and the level bed obtained insures that this face of the mold will be circumferentially true and all within it in the same level plane. One of the greatest difficulties to be overcome in flywheel castings is the distorting and fracturing defects caused by contraction, due to the inequalities of the sectional metal thickness between hub, rim and arms. As the latter two are more directly affected, being the lighter bodies and having to withstand the contracting strains of both the rim and hub, the curved arm pattern is commonly assumed to be the most efficient as the curvature takes up the strains and yields to both rim and boss, becoming slightly distorted from the original curve.

Theoretically this is correct, but further provision must be taken by the foundryman to counteract contraction effects, or the results will prove equally as disastrous if the arms were of the straight-arm pattern. For the latter, special precautions are obviously necessary as the *draw* in every case is directly opposed to the lighter body of the arm. From the foregoing it will readily be understood that a proportional rate of cooling between the various sectional thicknesses is necessary so that an equal contraction *set* is obtained upon the metal when it attains atmospheric temperature. One of the most common methods adopted to attain a proportional cooling rate consists of opening and exposing the mold at the heavier portions after the casting has solidified, and at a slightly later period, the next heavy part, the lighter parts being enabled to retain their heat by keeping them fully covered. Further heat is transmitted to the lighter parts by placing hot runners and risers over them which are also covered up so that their heat may be absorbed by the casting where it is desired to prolong the higher temperature for a required period. As the foregoing and similar precautionary methods for obviating the defects due to contraction are not entirely reliable, owing chiefly to unknown stresses developing while the wheel is in motion causing it to burst, a common procedure is to split the wheel through the hub or boss—often termed the *nave*—making a definite rupture or ruptures—at a specified position. By doing this, the metal, during the contracting period, develops along the line of least resistance, which in these cases, is in the direction of the wheel rim, assuming this to contain the heaviest body of metal. This method, of course, is distinct from making the wheel in two or more sections, as the rim would remain unbroken and continuous, the boss only being split. To part or split a wheel, an iron plate, well covered with tar, or a plumbago paste consisting of plumbago well mixed with loam, is placed into the mold and its line of intersection is obviously the parting line of the casting. This method is more fully dealt with in Fig. 9, which shows the pattern of a flywheel to be made in three sections. The practice would be the same for any number of sections, which subsequently could be assembled at the rim joints by means of pins passing through one joint into the other and secured by means of cotters driven through them.

Patterns for Large Wheels

The hub has provision for bolting by means of lugs, or by turning the boss to a given size a shrunk ring can be utilized for binding the wheel parts together centrally. Although the wheel under consideration is required in three separate portions, it is molded in the same manner as if required to be made in the one piece, the separations being made in the mold previous to casting by means of split plates. As this class of wheel is usually confined to abnormally large wheels of which only a small number is required, if a pattern is desired it is made up, in its rim part, of thick segments and of a common quality of wood. If the width of the wheel face is excessive, narrow segments for the external and internal parts are utilized, leaving the pattern hollow between. Only one face is fully covered, this being the cope, which is rammed upon, but the other is left open as shown in Fig. 10.

Skeleton Arm Pattern

The arm, either straight or curved, is made up in skeleton form, being built upon a center plate, *C*, Fig. 9. This plate is cut to a part of the external shape of the arm, to the shape of the ribs, *R-R*, and the continuation from these of the lugs, *L-L*, and boss part, *P*. Its thickness, in many cases, can conveniently be the same as the ribs *R-R*, but if these are excessive and tend to the use of material of unnecessary thickness, lighter material can be employed, and the thicknesses of the ribs made up. The plate is made to penetrate through the rim, the segments of the latter giving it support. A center web, *D*, is placed centrally upon both sides of the plate, *C*, and is continuous from boss to rim, giving the sectional thickness of the arm in the direction of its minor axis. At various positions guide pieces *S*, are placed and the intervening spaces are formed by loam or plaster of paris. The latter material makes a strong form of arm, being worked to shape in precisely the same way as loam, the guide pieces, *S*, acting as the directors for shape. To save weight and incidentally plaster, broken coke is first laid within the spaces (section *B-B*) at *E*, Fig. 9 and bent nails are driven into the guide pieces, *S* and *D*, to give support to the plaster, *F*, which is placed over and brought to shape. Assuming that the attaching of the rim parts of the castings is to be obtained by pins and cotters, the necessary holes for these are cored out by means of the prints, *P*, which are placed upon both faces to give top and bottom core support. From the holes cored-out by these prints, further circular holes are required which extend to the rim joints. These also are cored-out and in the core box which forms the cores for holes *P*, pocket prints are formed to carry them.

In Fig. 11, the core box—one side removed—with the prints, *A-B*, is shown and as will be noted, the print at *B* is

of a lesser thickness than *A*, this being necessary to give end support for both cores. These cores are placed into their prints *P*, and the splitting plate, which is made up of sheet metal, is drilled through this required core size which is the connecting pin size. These holes in the plate are of the same relative positions and size as the pocket prints, *A-B*, and their position is definitely insured by the metal split-plate being of the same size as the joint print placed upon the joints of the rim and hub of the pattern, Fig. 9. The thickness of these prints is the overall thickness of the split-plate when it is coated with tar, plumbago paste, etc., usually ranging from ¼ to ⅝ inch. These prints are only necessary upon the joints shown, so that on the pattern, when placed into its next position for molding, the impressions act as guides for position. Previous to placing the split plate into its mold position, the required circular cores are passed through the drilled holes of the plate and it is then lowered into the pocket prints impression *A-B*, and also the pattern print impression.

The pocket print spaces not occupied by the passed-through cores are now filled and in Fig. 12, plan and sectional views of these cores are given. It does not follow that the cores for the pins should always be circular, as the pins may be of an irregular shape and consequently the split-plate holes and cores, are the pin shape, the pocket prints following out the same contour at their support ends. In the example cited, no holes are required for the hub, a plain covered split-plate placed into its print being only required for parting purposes, but if holes were required the procedure would be similar as for the ring, but extension prints upon the pattern would be required to give support to the cores which would pass through the split-plate as previously explained.

To make allowances for the split-plates in regard to the required diameter of the wheel, when the parts are cast and by the intervening plates, becoming separate portions, the face-bored *A*, Fig. 7, at *B* is given an extended radius so that circumferentially the wheel is molded larger, but when cast up and the plates removed, when placed together gives the prescribed circumference.

Use of Strikes and Cores

In many cases flywheels are molded by means of striking boards and cores, these being applied for both green and loam sand. The striking board is required to sweep-up the rim, and the cores from the arms and nave. Taking the same example, Fig. 1, to be made by this method one form of arm core box is shown in Fig. 13. Two side pieces, *A*, form the angles of a section of the wheel, one side being rebated into the other and firmly screwed together. A piece, *C*, cut to the required internal diameter of the wheel, with also the arm tip fillet, is made to fit into the sides *A*, these latter being cut back to receive them and, at the same time, forming a definite stop for position. The hub, with its root fillet and print, *R*, for the central core, also is fixed permanently to both sides and the arm, *B*, is attached to both the internal rim and hub by means of dowels at each end, the root end having two dowels so that there is no lateral movement. The rammed-up core is relieved from this box by removing the screws from the outer piece, *C*. These screws pass through the sides *A* into *C*, the latter being drawn as one piece away from the core in the direction *F*, Fig. 14. The sides, with the hub, etc., are drawn in the opposite direction, leaving the arm within the core, this being afterwards withdrawn in the direction *D*, Fig. 14.

Core Sweep

As many wheels of this type are required of only differing diameters the hub, arm root, and tip remaining of a standard size, a core box with an extension piece and core sweep are frequently adopted to obviate the making of many frame boxes. A box of this kind is shown in Fig. 15, being constructionally the same as regards its outer frame as in the previous example. Placed within this box is an extension piece, *E*, composed of two pieces of wood abutting upon two surfaces and screwed together carrying upon one piece an arm tip fillet. This is fixed in position by screws passing through the box sides into battens fixed to the pieces forming the extension piece. The required intervening arm length is previously placed into position by means of dowels in both root and tip piece. Frequently the surfaces of the latter are *shod* by metal plates, *P*, which may contain the pegs, or alternatively, the eyes of the dowels. The arm dowels are made to suit these plates. After the core is rammed within the extension piece, it is struck level with the upper surfaces of the box sides, and the extension piece with the arm tip is unscrewed and removed. A spindle is placed into a hole drilled to receive it, the center of this hole being of a corresponding center to the wheel center, Figs. 15 and 16.

A core-board *A*, Figs. 15 and 16, slotted-out, as at *C*, Fig. 16, carries a sweeping board *B*, which is set to the required radius and affixed by means of bolts, *D*, passing through the slot, *C*, of the board *A*. This is placed over the spindle and gradually lowered down, sweeping away the sand and giving the desired radius. The board is then removed, the box sides drawn and cleared from the core, the arm piece being afterwards removed as in the previous example. Varied rim widths are obtained by lessening or extending the core prints which retain these cores into position.

Alternative Method

An alternative method of forming a similar type of core box, Fig. 13, is to split the arm centrally and attach the two pieces upon the sides of the box as shown in Fig. 17. The radius piece, *C*, with the tip fillets is worked loose, similar to *C* in Fig. 13, being jointed at *J*, but no loose arm piece is required which is advantageous as all loose pieces are liable to be broken or lost. Cores made from this class of box more readily adapt themselves for blackening if the arm length is considerable, but if they require *carding* or rubbing, owing to inaccuracy of the joint angles—which may be due to drying—the sectional thickness of the arms are affected, which is an obvious disadvantage. When the arms are curved and are required to be made up within a core, the box is made up as shown in Fig. 18 and in these instances the arm is a fixture to both hub and rim, its removal from the core being obtained by jointing down to it midway, forming a bearing surface at this position with sloping joints to the core surface. This joint is parted and the space refilled, a wire core-grid being bedded in the latter, giving the stability and support which is necessary for this portion of the core, as it is required to be a loose core-piece or as it is termed a *core drawback*. When the core drawback is formed it is removed from the box and the core box, after being well rapped, is lifted off and away from the main body of the core, the drawback being then replaced into its former position and permanently fixed as a whole with the main body. If the internal section of the rim is to be similar to the section *A-B* at *C*, Fig. 1, then the core-box at *C* is made to work loose from the sides as in Figs. 13 and 17. To form the mold for receiving these arm cores with also the required rim, either green sand or loam can be employed. In the case of the former, quicker and cheaper production can be obtained as fuel and time for drying obviously have their separate costs. In the case of loam work, the necessary tackle, such as foundation and building plates are required and these costs have also to be considered as against the advantages derived from a thoroughly dried mold. Furthermore, loam has the advantage in that it

can be swept-up correctly and uniformly by means of boards only, whereas in green-sand-swept molds making-up pieces are an absolute necessity to obtain sharpness and definition.

To sweep up the mold in green sand for the examples shown by Figs. 1 or 4, a prepared lid is first made up in the foundry floor and according to the size of the wheel, the necessity for under-venting it may consist first of a coke bed with vent pipes leading from it to the floor surface. Upon this a spindle run, with a spindle is placed vertically, sand being placed over and around the spindle and rammed lightly to the floor surface. The spindle is allowed to protrude a definite height above the rammed sand surface. A board *1*, Fig. 19, is attached to the spindle and is revolved sweeping up the *reverse* face surface of the rim with also the *reverse* core print. This board is removed and all sharp edges are made by means of suitable making-up pieces formed of wood and the entire mold is *sleeked-over* and dusted with parting sand. A cope box is next placed over the mold, it being sufficiently large in size to entirely cover and give a bearing surface in excess of the wheel's diameter. This is staked around to insure its position and carefully rammed up over the swept-up surface, being then withdrawn and possessing the required *mold* surface for the wheel casting with also a print impression for receiving and giving top stability to the arm cores.

A runner for the delivery of the molten metal is cut through at the hub position as this, in the majority of cases, is the most convenient and effective place for obtaining an even distribution of the metal throughout the mold. The cope bar, *A*, is not a full cross bar from side to side of the flask, but is only a projecting piece and not in any way interferes with the runner. Risers also are cut through, their position being from off the rim face, and in number must be sufficient to insure through feeding throughout the entire rim, which obviously in turn feed up the arms. A board *2*, cut to the full rim depth of the wheel with also the remaining wheel face and bottom print radius and thickness, is placed over the spindle, revolved and worked down until the board edge at *D* comes into contact with the surface, *C*, struck up by the reverse board *1*. The struck up edges of the rim are made by means of the making-up piece *A*, Fig. 20, which has attached to it a carrying rod drilled at the required center—radius *X*—with a hole the spindle size. This is moved around and the mold is made up where required by its means acting at the same time as a *sleeper* for the outer diameter (radius *X*) and the face (radius *Z*). The bottom print, around its edges, is made up by the piece shown in Fig. 21, which at *R* is the required print radius and is of the same thickness as the struck-up print depth. The entire mold surfaces are then black-washed—in some cases being previously skin-dried—and the arm cores assembled into position as shown in Fig. 22. The hub core *P*, Fig. 1, is then placed into the print *R*, formed by the assembled arm cores and the cope, or the top part, is returned to its former position and vents carried through the mold to the arm cores surfaces, thus insuring free outlet for the air and gases from the cores. The whole is then weighted down and prepared for casting by placing a large runner basin over the gate (the runner formed off the hub) and riser-cups above the risers formed off the rim face, all of these acting as feeders to the main body.

Contraction Allowances

Referring again to the contraction allowances for these castings, in large wheels it is common practice to cast at the same time as the wheel, *hot blocks* which are heavy bodies of metal required to place over and, assist in, retaining the heat of any portion that is likely to cool at a quicker rate than the part contiguous to it. When placed into position, these are covered over in the manner described when riser-heads are used for the same purpose. Also, in every case the hub core is removed as soon as solidification has set in and the whole allowed to slowly cool which may involve days according to the size of the casting.

In the cored-out arm examples given, the combined arm cores fill up entirely the spaces intervening between each arm, but in some cases the greater proportion of these spaces are filled up with cinders, this giving a desirable openness to the mold for venting purposes. As will be seen in Fig. 23, the core box in these cases is rectangular, and contains one-half only of the arm and, at the wheel hub, is formed to an angle which corresponds with the number of arms. The spaces, *C*, cut through the box sides, are to allow the lugs formed on the core-grid to project beyond the cores formed. These cores, after being made and dried, are pasted upon their joint surfaces—two cores being required to make on full arm core—and wired through the projecting grid lugs *A*, Fig. 24, giving entire rigidity to the core. When placed together in the mold, as shown in Fig. 24, the intervening spaces between the cores are rammed up, a section piece, *B*, cut to the internal radius acting as a guide and support during the ramming up of each space.

Flywheels of the center-plate type, Fig. 25, with lightening holes, *B-B*, are invariably struck-up in loam, this usually being the most convenient method to adopt. The procedure for forming a mold of this kind and for the example, Fig. 25, can be applied to any similar form of wheel.

Upon an iron building plate *A*, Fig. 26, the one surface of which is prodded with projecting rods of varying lengths cast into the plate, and also perforated with holes for venting purposes, a spindle-run, *E*, is attached, and a spindle, *F*, placed into its socket. A course of bricks are laid upon the plate surface being bedded into loam which intervenes between each brick. A loam board, *1*, which will sweep up the top part of the required mold, is then attached to the spindle and further courses of bricks are built-up, loam surrounding each brick surface. The board, as it revolves, sweeps away the loam to its cut edge, a loam thickness from the bricks to the board edge of about ¾ inch to 1 inch being allowed. The board also sweeps up at its cut edge *R*, a register which latter is to define its position with the bottom, or remaining part of the mold when they are assembled. This is now placed into the oven and thoroughly dried. In Fig. 26 one-half of this mold, showing its external swept-up appearance, is illustrated, the other half giving one-half the mold in section, with the board *1* in position, which position is kept by means of a screw, *S*, passing through the spindle bar, *B*, into a V cut into the spindle, or, alternatively, a collar placed under the boss of the spindle bar, which is kept in position by means of a screw attached to the spindle and through the collar.

The bottom part of the mold, Fig. 27, is built-up in a similar manner and is swept-up to shape by means of a board *2*, this latter also sweeping up a seating to receive the register formed upon the top mold. The lightening holes, *B-B*, are cored-out by separate loam cores made to shape in a flat core box and placed into their respective positions while in their plastic condition, so that surface contour is quickly and accurately obtained without the expense entailed by making the core box of the surface contour required. These core positions are marked upon the surface, the outer and external diameters being struck out by a scriber held against the marks, *C*—inscribed upon the loam board—as the latter rotates. These circles, when divided, will obviously give positions in the direction of the cores ends.

In Fig. 28 the assembled mold is shown in section, *R*, being the main run-

(*Continued on page* 203)

How to Prevent Pattern Shop Accidents

Injuries Caused by Woodworking Machines Are Usually Severe, But May Be Almost Entirely Avoided by Adopting Proper Safeguards

By Mancius S Hutton

THE accidents which happen to those operating woodworking machinery are likely to be serious and permanent in nature. Statistics show that they are only exceeded in number by those caused by stamping, punching and drilling machines. They, however, can be largely prevented by placing safeguards over the danger zones of the machines. Each safeguard should, if possible, meet four conditions:

It must not hamper the workman by preventing him from turning out the maximum number of pieces per day.

It must be of such a nature that it can be easily adjusted without consuming time when changing the character of the work.

It would be advisable to have it so fastened to the machine that it cannot be easily removed and thrown aside by an employe when using the machine, which occurs frequently in shops.

It should be fool-proof.

It is not often that a safeguard can be found that will measure fully up to all the four conditions mentioned above, but it is advisable to have these in mind when selecting a guard for protecting a particular danger zone of a machine.

In practically all pattern shops the following four machines will be found: Circular saws, band saws, lathes and jointers. In the larger up-to-date shops there will be found,

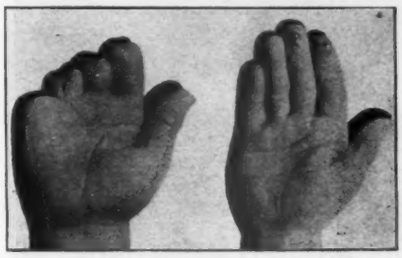


FIG. 1—FINGERS CUT BY JOINTER HEAD

besides the above, the following three machines: Shapers, surfacers and universal wood workers. Of these seven machines, the circular saw, band saw, shaper and jointer are by far the most dangerous to operate. The other machines do not have many exposed parts to come in contact with the operator and they can be guarded at a small expense.

The circular saw is the machine which is used the most and at the same time it is the most dangerous of all woodworking tools. There are three types of circular saws, namely, the rip, cut-off and swing. The last type is not used in pattern shops. The guards, later described, will be equally serviceable in protecting the workman using either the rip or the cut-off saws, as the same dangers are present in both.

The two accidents which are likely to happen to an operator using a circular saw are, first, the probability of the man getting his hand or fingers in front of the teeth of the saw; and, second, of the wood which is being cut, becoming pinched at the back, throwing the piece in an opposite direction to which it is being fed.

When a saw is revolving at high speed, the space between the teeth showes up lighter than the solid part of the blade, making the saw seem to be smaller in diameter than it actually is. To prevent the possibility of the operator's fingers or hand coming in contact with the saw, a hood should be placed over it. This hood can be made of either metal or wood or a combination of both. It should cover the sides as well as the top. The guard should be arranged so

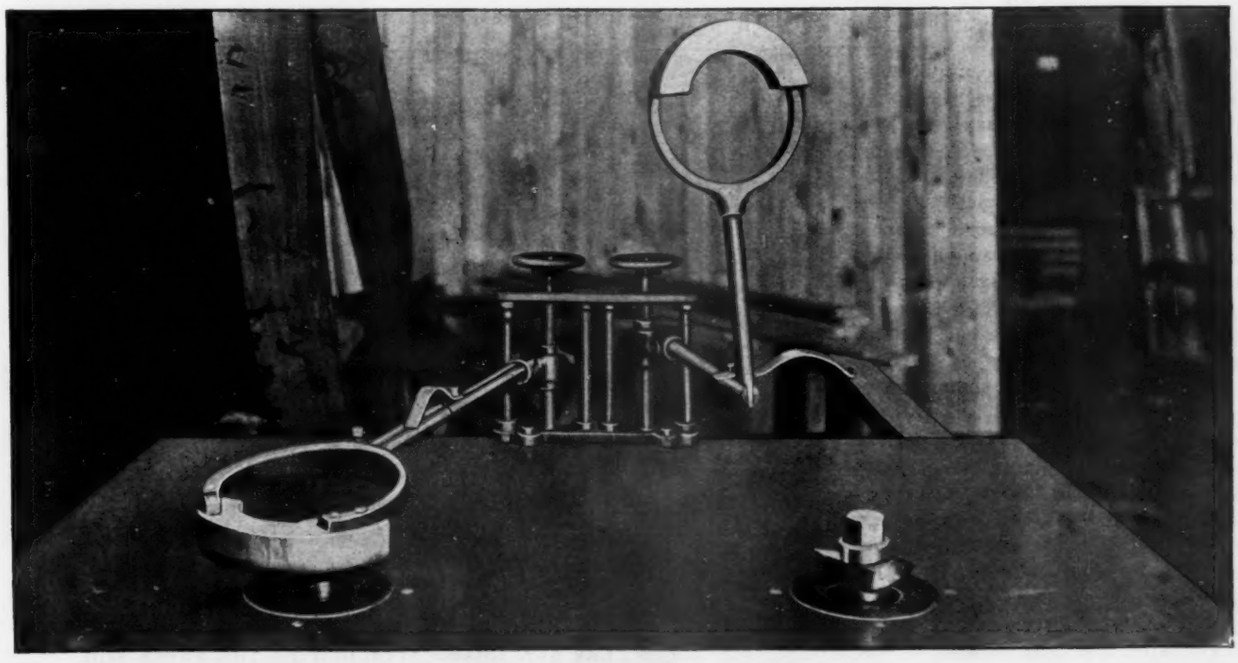


FIG. 2—ADJUSTABLE RING TYPE SHAPER GUARD

FIG. 3—RISING TYPE OF JOINTER GUARD

that it will cover the saw completely when not in use and will adjust itself automatically for various thicknesses of stock without requiring hand adjustment. As an operator usually cuts a piece with the saw by either a line on the wood or by judging the same with his eye, it is quite essential that the top of the guard should be open and the front should have a small lip for starting his work and following it through. The sides, if of metal, should be at least a half an inch from the blade, but if of wood, they can be brought closer together. The reason for this is that unless the hood or saw is absolutely steady, there will be the possibility that the teeth may come in contact with the sides, injuring them. The hood must be so attached that it can be moved out of the way of the saw when the operator wants to make a change or do repair work. It is usual to have the hood attached either by a counterweighted rod to the ceiling or to an arm fastened to the side of the table. The saw table in a pattern shop either is of the tilting or non-tilting type. The guard suspended overhead can be used on either of them, but the guard attached to the table can be used only on the latter type.

As previously stated, the second danger with this type of saw is that due to the stock becoming pinched and thrown away from the saw. The force with which the piece may leave the saw is sometimes tremendous, especially if it is heavy stock. Pieces have been known to be hurled long distances doing great damage in their flight. Many a man has lost his life by being struck with one of these pieces of flying stock. It depends somewhat on the weight of the stock whether the wood is projected along the table or lifted and thrown at a tangent to the saw blade, the heavier stock being in the former class while the lighter materials are the ones which are apt to be lifted before being projected from the blade. The reason why stock which is being cut is liable to be thrown from the operator's hand is that the sides of the freshly-cut part of the piece come in contact with the rear teeth of the saw. Therefore, an accident could be prevented if these sides are separated as is done by means of what is known as a splitter, or if means are found to hold the stock from moving except in the direction of feeding. This is accomplished by what the writer proposes to call a dog. The splitter, or spreader, as it is called, consists of a piece of steel fastened to the table at the rear of the saw and in its plane. It is beveled at the edge nearest the saw and is made a little thicker at its rear than at the front, the thickness at the front being the same as the thickness of the saw blade.

Construction of the Dog

The dog consists of a curved lever pivoted to the hood, with ratchet teeth on its under side. The teeth of this lever have their backs sloped in the direction in which the stock is moving, allowing the piece to slip by when being fed normally; but should the saw teeth tend to reverse the motion of the stock, their sharp crests dig into the wood and arrest the motion in that direction. A safety device which is to prevent circular saw accidents, therefore, should consist of both the hood and either the spreader or the dog. At present a number of different companies man-

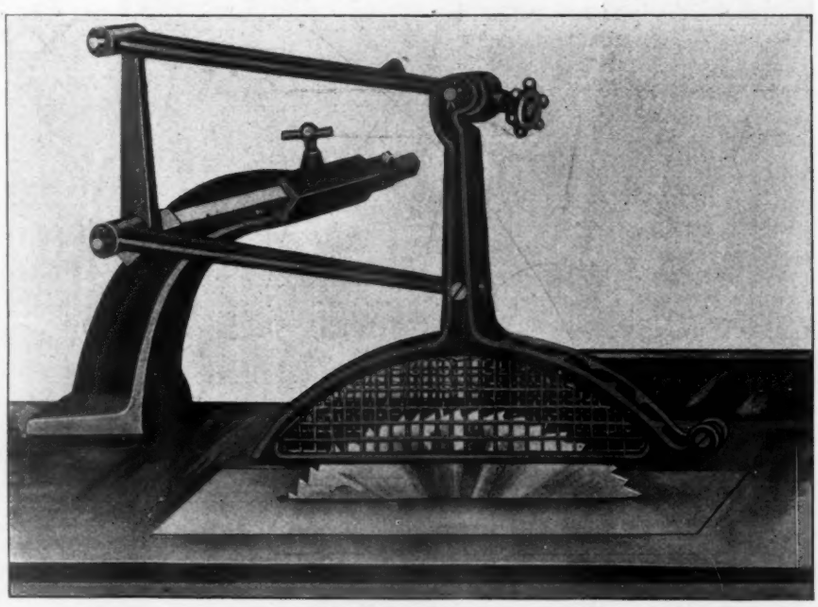


FIG. 4—CIRCULAR SAW GUARD ATTACHED TO THE TABLE SIDE

ufacture these safeguards for sale, and in addition, a number of manufacturers using saws have attached guards which they designed and built in their own plant. Fig. 6 shows a hood which is suspended overhead and Fig. 4 illustrates the hood attached to the side of the table. A guard which can be cheaply made and at the same time meet conditions, will be one having a hood whose sides are two pieces of wood held together by a wire mesh across the top and sides. The hood may be attached to the side of the table at the rear by means of an arm and have a dog fastened to one of its sides at the bottom and close to the rear. A sawyer should never stand in front of the work nor should he use his breast or abdomen for feeding a piece.

Use of Band Saw

The band saw is much safer to operate than the circular saw and the accidents which are liable to occur are not so serious. There are two dangers to contend against, but the guard which will protect the workman from the one is just as serviceable in protecting him from the other. The first of these is caused by the band saw slipping off from either the upper or lower wheel, and the second by its breakage.

Covering the two sides of both wheels with wood, slats, metal or a wire mesh guard will prevent the band from slipping off provided the sides are brought close enough together. Both of these wheel guards should be so arranged that one side can be opened in case a new saw is to be put on or to replace the broken or dull one. It is sometimes arranged so that the upper wheel guard can be slipped off instead of having a side opening. Should there be no covering over the upper wheel and the saw slips off, the operator probably will get his hand or face, or both, badly cut with the teeth of the saw, unless he is fortunate in getting out of its path. If there is no guard over the lower wheel, his legs will be cut. If the return part of the blade should be exposed, the operator or some one else may come in contact with it or the saw may be struck from the rear and thrown off the wheels. This part of the machine may be protected with two strips of wood or metal between which the blade moves.

FIG. 6—CIRCULAR SAW GUARD SUSPENDED FROM OVERHEAD

Of the dangers mentioned, the second or the breakage of the saw blade is the one which causes more accidents to the operator than the former. For the upper wheel it will be necessary to cover its face so that the broken end cannot reach the operator and injure him. Enclosing the sides of the lower wheel also will be necessary. The wood or metal piece which fastens the two sides of the wheel guard will serve this purpose. It is quite necessary, in fact, imperative, that the working part of the blade should be guarded. First for protection in case of breakage, and second, to keep the operator's head from coming in contact with the saw when he bends over to follow the pencil lines which he desires to cut. If the machine had no guard for this purpose when it was bought from the manufacturer, one can be made of two strips of wood or metal on either side of the blade, arranged in such a manner that they can be raised or lowered to any desired height, leaving exposed only that part of the saw in actual use. Fig. 9

FIG. 5—SLIDING TYPE OF JOINTER GUARD

illustrates a machine which has all parts fully protected.

The jointer, or buzz planer, ranks next to the circular saw in its capacity for doing bodily harm to the operator. The dangers are those due to the fact that the operator, in most cases, has to depend wholly upon his hands for the control of his work. The accidents which happen are due to two causes. Should the operator

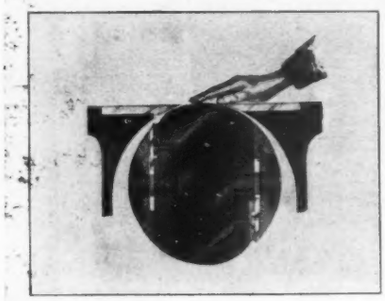


FIG. 7—CYLINDRICAL CUTTER HEAD FOR JOINTER

stand in front of the planer, the work may fly back and strike him in the abdomen, causing an injury which may be serious. The only way to prevent this is to see that all the employes are instructed to feed the stock when standing at the side of the machine. Not only they be instructed, but it should be seen that this rule is implicitly followed. The second danger is that due to the operator getting his fingers in the path of the revolving knife head. To plane the stock, the operator must push it with both his hands over the gap between the two halves of the table in which the knife head is revolving. Besides pushing the stock he must bear down on it in order to obtain the desired depth of cut. Should there be a knot or a change in the grain of the stock, or should too heavy a cut be taken, this will cause it to fly out from underneath the operator's hand and allow the latter to drop down over the cutter. To lessen the amount of injury, the jointer should be provided with a cylindrical head. The use of the old style square head results in a far more serious accident than that due to the cylindrical one, as is illustrated in Fig 1. These two types of knife heads are illustrated in Figs. 7 and 8. Besides having a cylindrical cutter head, there should be provided some type of safety device to be placed over the gap between the two halves of the table in which the cutter revolves.

There are two types of guards manufactured for this purpose which are called the sliding and the rising type. In the former class the guard, which is of wood or metal, is pushed aside by the approaching material, uncovering only so much of the knife length as is required for the work. As soon as the material has passed by, a spring brings the guard back to its original position over the knives. This type of guard is illustrated in Fig. 5. The rising type of guard is one that can be adjusted horizontally as well as vertically or swung to one side to meet various conditions in planing. It is usually made of solid or perforated metal. The guard is supposed to be adjusted vertically so that it lies on top of the material being planed, in which position the hands will be forced over the top of the guard when they reach it. Fig. 3 illustrates this type of guard. There are now in use self-feeding jointers which eliminate much of the danger attached to the operation of the machine. In working short pieces special care should be exercised in feeding because the pieces due to their lightness and the difficulty of holding them close to the table are liable to be projected from the table by the knives placing the fingers of the operator in danger. For such pieces the danger to the operator will be minimized by the use of a push block made in the shape of a hand plane with a cleat at the back to place over the end of the stock. On the underside of the block is a notched metal plate to hold the material firmly and prevent any sidewise movement.

If the belting at the lathe is covered by means of a wood or metal guard and a shield is placed over the face plate and spur gears, the machine would be protected over the most dangerous parts. There is always the possibility of the tool slipping and bruising the hand, but in the hands of a competent workman this would never happen.

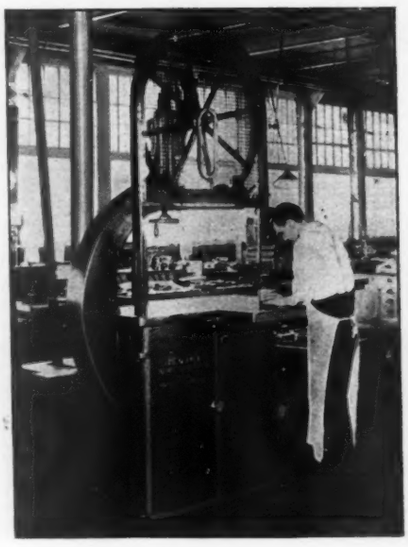


FIG. 9—BAND SAW GUARDED

The shaper is exceptionally dangerous because of the necessity of running the knives at a high speed in order to give a smooth finish to the piece being cut and because of the

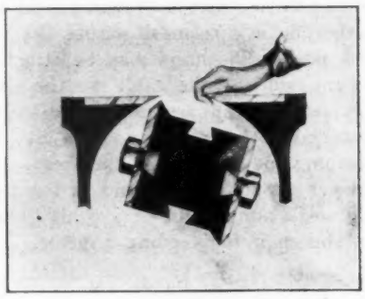


FIG. 8 — SQUARE CUTTER HEAD FOR JOINTER SHOWING DANGER OF ACCIDENT

fact that the wood must be guided by hand. There are a few cases in which a guard with a self-feeding attachment can be used, but such cases do not often present themselves in a pattern shop. This machine is used for such a variety of work that it is particularly hard to find a universal guard. Guards are made, or can be made, which will serve most of the purposes required in a pattern shop. Such a guard must serve both as a protection against the dangers of the operator's hand getting in the way of the knives and at the same time must act as a tension on the piece. There are a number of American manufacturers who are selling shaper guards. Some of these are builders of woodworking machinery, others are manufacturers of different safety devices. The one illustrated in Fig. 2 is good. It consists of a horseshoe piece of wood attached to the forked end of a metal arm. This arm is connected at the other end to a vertical screw which is attached to the table as shown in the illustration. By moving the screw up or down the desired pressure on the work can be given by the guard. The arm is jointed so that one end can be lifted to make any changes to the knives. When it is in use, a spring supplies the proper tension so that the two halves of the arm act as a solid piece. It is essential that the chips and shavings should be kept away from the work. If there is no mechanical means of doing this, the operator is likely to try to brush them away with his fingers, thereby endangering them. It is for this reason that exhaust systems have been

used quite extensively with this type of machine. The suction pipe opening should be a flat orifice which can lie on the table close to the knives and it should be of such a nature that it can be swung around to any desired position. It should be further noted that if the knives are not securely fastened they may fly off the spindle to which they are attached and cause an accident. Therefore, the operator should see that they are held fast on the spindle before he starts the work.

The surfaces should have a substantial bar guard in front of the feed roll or entrance, to prevent the operator's hand following the stock into the rollers. It should be fastened to the frame carrying the roll so that it will be in adjustment for any thickness of stock. It is advisable to use a sectional feed roll to allow feeding stock of different thickness without the danger of the thinner pieces being kicked out.

Universal Woodworker

The universal woodworker does a large amount of work which formerly was done on several machines. It requires practically no guards, as the workman does not have to bring his hands near the cutters in order to operate the machine. This machine is one that is used only in pattern shops requiring special work.

The author wishes to acknowledge his indebtedness to the Lockhart-Hodge Co., Buffalo, for the photographs from which Figs. 2, 3 and 4 were made, and to the American Museum of Safety, New York, for Figs. 1, 5, 7, 8 and 9.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Melting Bronze in a Cupola

We have an order for a bronze sleeve which will require about 1,200 *pounds of metal, and, owing to our limited facilities, the metal will have to be melted in a cupola. Will you kindly advise us how to proceed? The mixture that is to be used will contain* 90 *per cent copper,* 4 *per cent lead and* 6 *per cent tin.*

Use a clean cupola and operate it about the same as when melting iron, but a higher melting ratio will obtain for copper than for iron, as there is a considerable difference in the melting points of the two metals. In one instance the melting ratio was 1 of coke to 7½ of brass. The fire was started at 11:00 a. m., the blast was put on at 12 o'clock and the first brass appeared at the cupola spout at 12:03. The first metal was tapped at 12:13 and bottom was dropped at 3:04. As there is a considerable variation in cupola practice and since we are not familiar with your methods, we can only suggest that the usual practice for iron be closely followed for melting copper.

If you desire to make an alloy, however, the proper proportions of tin and lead should be placed in the bottom of the heated ladles, the copper being tapped onto this white metal mixture. The surface of the other metal then is covered with granulated charcoal to prevent oxidation. To insure sound castings, use 1 per cent of 15 per cent phosphor copper, which should be placed in the bottom of the ladle with the rest of the mixture. If a phosphor copper is not available, manganese copper can be employed. This can be made from ground ferro-manganese and copper.

As ferro-manganese usually is available in an iron foundry, manganese copper easily can be prepared by melting the copper in a crucible and when hot, the ferro-manganese is added in the proportion of three pounds of ferro-manganese to nine pounds of copper, which will give an alloy containing about 16 per cent manganese. Superheat the copper for 30 minutes before adding the ferro-manganese and use in the proportions of ¼ of 1 per cent in bronze. However, phosphor copper is preferred because it produces a much more fluid metal.

Matching Color of Castings

We recently received an order for a number of street car axle bearings, together with a sample showing the kind of metal desired. We have made a number of these bearings from a mixture consisting of copper, 80 *per cent; tin,* 10 *per cent, and lead,* 10 *per cent, but the color is considerably lighter than that of the sample bearing. In addition, the metal also is considerably harder. The sample bearing has a reddish color.*

The 80-10-10 mixture which you have used no doubt is superior for bearing purposes to the metal of which the sample is composed. The latter undoubtedly is an ordinary red brass, containing lead, tin and zinc, and probably is not well adapted for bearing purposes. The following mixture would give you approximately the color of the sample: Copper, 88 per cent; tin, 5½ per cent; zinc, 3½ per cent, and lead, 3 per cent. A more satisfactory mixture, would be the one which you have used, or the following also can be employed: Copper, 78 per cent; tin, 7 per cent, and lead, 15 per cent.

How to Use Aluminum Solder

Will you kindly let me know how to use a solder consisting of 25 *per cent zinc,* 69 *per cent tin and* 6 *per cent aluminum?*

Undoubtedly this solder is to be used on aluminum and the first operation should consist of tinning the edges of the latter where the joint is to be made. Apply a torch or other source of heat to the aluminum until it is sufficiently hot to melt the solder, and then rub the solder on the aluminum with a file or other sharp tool. The object of this operation is to scrape off the film of oxide and to simultaneously rub on the solder. In this manner the aluminum can be tinned provided, of course, that the solder is suitable for the work. After the joints have been tinned, finish soldering in the usual way.

German Silver Difficulties

We are experiencing considerable difficulty in obtaining sound German silver castings made from alloys containing respectively, 20 *and* 27 *per cent nickel, the balance being copper, zinc and iron, with some lead and tin. The castings when machined develop drossy spots and blowholes. The castings which we are making are semi-circles and we have molded them both flat and upright, but have succeeded better when casting on end, the dross then being largely in the cope. Eight of these castings are on a gate. The cope is rammed light and a thin strip of brass is laid across the top of the eight patterns to carry off the vent. We pour the metal as cool as possible, but it is necessary to have it flaring hot*

to force the metal over the arch and down into the opposite end of the castings. Invariably drossy spots are on the top edge, the trouble being intermittent, but the losses from each pot vary from 15 to 35 per cent. These castings must be clean and homogeneous and a good nickel or silver color must be maintained, strength being of little consequence.

Manganese copper usually is added to German silver as a deoxidizer and we would suggest the use of 1 per cent of this alloy. The addition of two ounces of aluminum per 100 pounds of metal would greatly assist in running these castings. You might succeed in minimizing your losses by molding these castings concave side up. By this method the metal would not be required to run up into the mold to fill out the mold cavity. It also might be advisable to incline the molds from the sprue, placing the vent strip on the free ends of the castings.

Mixture for Carburetor Castings

We are using the following mixture for carburetor castings: Copper, 88 per cent; tin, 10 per cent and zinc, 2 per cent. Kindly advise us if a better mixture can be used for this work. In making this mixture would it be advisable to use gates and return shop scrap? As the thickness of these castings is only ⅛ inch, would it be advisable to add phosphorus to the mixture, and if so, how much and how should it be used? How will I be able to tell when the brass is sufficiently hot to cast, and how can I tell when the metal is burning in the furnace? With reference to the molding sand, would it be advisable to use salt and molasses water, and if so, how should the mixture be made? Also let us know whether the molds should be coated with a graphite facing. I would also like to know what kind of a core sand mixture to employ for carburetor cores, and should they be coated with blacking? We only have beach sand on the Pacific coast, and I would like to know whether molding sand can be mixed with it to make the core mixture.

The mixture given is a good one and should be satisfactory for making carburetor castings. Gates and return shop scrap can be used in any proportion, but one-third scrap and two-thirds new metal would give a good mixture. Phosphorus can be added if the castings are spongy, in the proportion of 1 per cent of phosphor tin in place of 1 per cent of ordinary tin. As the castings are thin, the metal should be poured hot. When molten bronze is hot it will appear bright and liquid instead of dull and thick.

Copper and brass, or bronze, do not burn in the sense as applied to wood, coal or coke. There is no accompanying evolution of light and heat, as in the case of fuel, and consequently there is no visible change in the appearance of the metal when in the furnace. However, there are certain indications of oxidation or burning. In the case of copper, this is indicated by a strong bubbling or boiling, and in brass or bronze, thick or pasty metal will form on top of the bath. To prevent oxidation, cover the alloy with charcoal so that the metal is entirely hidden from view. Charcoal should be added with a cold charge of copper. By this method of procedure the metal is protected from the heated oxygen always present in the furnace. The entire copper charge should be added at one time, if possible, and to accomplish this, it is advisable to use a crucible ring on top of the pot. A ring of this kind easily can be formed from an old crucible by chopping off the bottom. The ring is placed on top of the pot when it is coked-up in the furnace. The copper is then charged, the charcoal added and the metal is melted.

When the copper is molten and if it bubbles strongly, add the zinc and stir well, following with the addition of tin. If phosphorus is being used, add the phosphor tin before the zinc. Usually zinc is not used with phosphorus, as they both are deoxidizers.

It is not necessary to employ salt or molasses in the sand for green sand work, but if the molds are skin-dried, they should be sprayed with molasses water before using the torch in order to prevent the crumbling of the sand. The use of graphite facing is unnecessary for small castings. These can be dusted with flour, using a bag for the purpose, and the excess flour can be blown off with the bellows.

It is not necessary to add molding sand to sharp sand for cores unless they must be handled green and in this case equal parts of molding sand and sharp sand should be used with one part flour to 10 parts of sand. For cores made in halves or when dryers are used, the following makes a satisfactory core mixture: 1 ounce of linseed oil to 2 pounds of moist sand.

Equal Parts of Copper and Lead

How can we make a mixture consisting of 50 per cent copper and 50 per cent lead which will not segregate?

Add 1 per cent sulphur to the molten copper, followed by the charge of lead. The mixture should be stirred well and poured hot.

Coke for Crucible Melting

Kindly let us have your opinion as to whether or not it is injurious for foundry coke for use under crucibles to become wet in shipment. We also would like to know whether the amount of sulphur in coke used under crucibles has any appreciable effect on the quality of the metal.

Wet coke is both wasteful and inconvenient to use. A portion of the fuel must be utilized in expelling the water in the form of steam before melting can take place and it is not satisfactory for use because fine dirt adheres to the coke when it is charged into the furnace, thereby clogging the grate bars and lowering the furnace efficiency. A new crucible never should be placed on a layer of freshly charged, wet coke, as it is liable to scalp and wet coke probably will cause alligator cracks in an old pot. For these reasons it is desirable that dry coke be employed for melting. High sulphur is undesirable in coke, but the amount absorbed by bronze is not sufficient to effect the metal adversely. If 1 per cent sulphur is added to a Government gun metal, it will cause a dirty appearance of the castings, but it does not seem to affect the structure. In the case of copper, the same amount of sulphur will produce a porous structure, but the castings will not swell at the sprue the same as if a similar amount of copper oxide had been added.

Mixture for Driving Brasses

What mixture is used for making locomotive driving brasses or bearings? Can you inform us approximately what the crushing strength will be of a mixture consisting of 80 pounds of lead, 10 pounds of tin and 10 pounds of antimony?

A good mixture for driving brasses follow: Copper, 85 per cent; tin, 10 per cent, and lead, 5 per cent. A mixture consisting of 80 pounds of lead, 10 pounds of tin and 10 pounds of antimony should carry a load approximately 500 pounds per square inch before failing by fusion.

Acid-Resisting Bronze

Kindly furnish us with a mixture for making acid-resisting bronze castings.

An excellent mixture for acid-resisting bronze follows: Copper, 78 per cent; phosphor copper, 2 per cent; tin, 10 per cent, and lead, 10 per cent. First melt the copper under a cover of charcoal and add the phosphor copper. After stirring the metal thoroughly, add the tin and then the lead.

How to Make Your Time Studies Accurately

(*Continued from page* 174)

not covered are such operations as the following:

Placing bottom board, pattern and drag.
Making joint.
Rolling.
Placing cope side of pattern and drag.
Lifting and placing cope.
Closing mold.
Making runners and heads.
Clamping and weighing.
Pouring and feeding.
Shaking-out.

These operations are not made up of the same range of variables as the operations previously discussed. Time for any of the operations just listed will of course vary with the different classes of work, but the difference in time for any one class of work is not, as a rule, sufficient to warrant working up formulas for them. Consequently the plan to follow is to make a series of studies covering the various classes of work and adding these times to those determined by the use of the formulas.

It is now necessary, in order to make the plan outlined of most value to foundrymen, to standardize the method of handling this information. As is necessary in machine shop and structural shop work, the foundry operations should first be analyzed. The combinations should then be worked up, the formulas applied and the times added for total standard time.

The course to pursue is to first make a number of studies, covering various kinds of work and then tabulate and classify the information. This will in a short time mean a considerable amount of valuable data, which, when considered class by class, will furnish the means for determining the proper factors for the various operations. Subsequently sufficient information will be gathered to cover all classes of work and the facts can well be termed the "standard practice" of the shop in question. Finally, slide rules can be worked up to cover the practice decided upon and for an excellent description of this device, with reference to the foundry industry, I would call your attention to an article by Charles J. Simeon on the "Scientific Operation of the Foundry" in the January, 1912, issue of THE FOUNDRY.

Just a word to those who may be contemplating the introduction of time study work. Unless you intend to make the right kind of a study of the men; unless your aim is their betterment as regards both health and earnings; unless you have the right kind of men to make the studies —men who are tactful, diplomatic and who will wear well with the workers, it would be best to refrain from starting the campaign. If, however, you are with those wise executives who see in their men more than mere bone and muscle; who see a side awaiting development, secure the right kind of time study men and start the work. The results will surprise both you and the men.

It should be remembered, however, that the time studies will not in themselves correct all evils. There are other important requirements. The analysis of time study data will reveal faulty and wasteful conditions, imperfect and inefficient planning, unstandardized operations and unless proper steps are taken to properly handle these elements, the time study campaign will fail to accomplish all that is possible. This, however, is not the fault of the time studies made, but of the management for not properly co-ordinating the various steps.

You can readily appreciate how futile it would be after studying a job and finding that eight hours was sufficient time to do what had taken 15 hours previously, to simply standardize the time and nothing else. This would be virtually putting it up to the men—the very thing we are trying to get away from.

Conditions should be put in the best possible shape; the most efficient planning and dispatching arranged for; operations standardized as regards methods of working and times allowed. Time study data properly collected, compiled and analyzed will pave the way most efficiently for this work and the only thing now remaining is to furnish the men with the incentives which will warrant them in taking full advantage of these improved conditions. I will not take the time to discuss wage payment methods, but I do want to impress upon you the fact that there is a law of wage payment which, if lived up to, will mean a surprising willingness on the part of the men to fully cooperate. This law is:

"Men at work will do their best and accomplish the most when engaged in work which stimulates; when rest balances exertion; when they can work efficiently rather than strenuously; when force and driving tactics give way to the leadership which attracts; when causes contributing to worry have been eliminated; when the attitude of 'mental impossibility' no longer keeps them from attempting greater things; when responsibility is properly divided and the inefficiencies separated as between the management and the men; when provision is made to cover the natural inertia due to habit; when they have faith in the intention of the management to deal fairly and honestly; when they are guaranteed against cuts in rates; when they do not deem it necessary to hold back and become deceitful in their attempt to influence rates; when they are given an amount to cover the time employed plus an additional amount which represents to the man the skill and co-operation displayed."

Local Committees for Chicago Convention

At a meeting of several officials of the American Foundrymen's Association, held at the La Salle hotel, Chicago, Saturday, April 4, plans for the convention to be held in September were tentatively discussed and the program was outlined. The meeting was attended by Alfred E. Howell, president; R. A. Bull, vice president; A. O. Backert, secretary, and H. B. Swan, member of the program committee.

A large number of papers already have been promised and there is every indication that the professional sessions will develop many new features of foundry practice.

At a luncheon given by the Chicago Foundrymen's Club, and at which the officers of the American Foundrymen's Association were guests, announcement was made of the election of the local committees in charge of the convention preparations. H. O. Lange, Ferguson & Lange Foundry Co., was elected president of the general committee; David Evans, Chicago Steel Foundry Co., secretary, and H. L. Hanson, Chicago Steel Foundry Co., assistant secretary.

The reception committee for the American Foundrymen's Association consists of the following: J. A. Galligan, Pickands, Brown & Co.; L. C. Young, McDowell Foundry Co.; William Francis, Francis & Nygren Foundry Co.; Eugene Smith, Crane Co.; Alex. Thompson, H. W. Caldwell & Son Co.; Thomas J. Sheriff, Sheriff Mfg. Co.; J. G. Girrard, Northwestern Malleable Iron Co.; James Wood, Sheffield Foundry Co., and J. P. O'Niel, Western Foundry Co.

The reception committee for the American Institute of Metals consists of the following: E. P. Welles, Charles H. Besly Co.; I. M. Bregowsky, Crane Co.; I. N. Perlstein, Great Western Smelting & Refining Co.; Fred Moerl,

Pullman Co.; Charles McNellis, Imperial Brass Mfg. Co., and Harold Wolff, L. Wolff Mfg. Co. Other local convention committees follow:

Entertainment Committee — A. G. McKinley, Griffin Wheel Co.; S. T. Johnston, S. Obermayer Co.; C. A. Hardy, Whiting Foundry Equipment Co.; C. E. Hoyt, Foundry & Machine Exhibition Co., and Harry Pridmore, Henry E. Pridmore.

Banquet Committee — C. B. Carter, American Brake Shoe & Foundry Co.; N. C. Peebles, Edgar Allen American Manganese Steel Co., and O. J. Abell, *Iron Age*.

Printing Committee — A. O. Sonne, Rogers, Brown & Co.; Richmond Nicholas, Hickman, Williams & Co., and A. B. Hawes, Mathew Addy & Co.

Rig for Molding Automobile Gear Cases

By H Cole Estep

THE rear axle housing for the differential gears of the Hupmobile motor car is made in hemispherical halves. The casting, which is of malleable iron, has an outside diameter at the large end of about 12 inches and the metal is about ⅛-inch thick. Each half weighs 16 pounds when finished, the sprue weighing 1½ pounds. The molds were first made on the bench, using a dry sand cover core to form the cupped interior of the housing. Considerable difficulty was experienced, due to the cores and flasks shifting, thus causing misruns. The losses were about 10 per cent.

In order to reduce the losses and at the same time increase the production, a special rig was designed by Betts & Elliott, 654 Franklin street, Detroit. This rig, it is said, not only brought about an appreciable increase in the production, but reduced the losses to 3 per cent of the total weight of metal poured.

The rig consists essentially of a specially-shaped drag together with a drag pattern and stripping plate, and a machine for molding the copes. The drag is shown at the right in Fig. 1, while the drag pattern with the bottom board and stripping plate are shown at the left. The casting may be seen at the right resting on the drag. The latter is built of wood in the form of a truncated pyramid, 15 inches square at the base, 9 inches square at the top and 12 inches in height. This shape was adopted in order to cut down the amount of sand to be handled. The drag pattern is raised about 2 inches above the bottom board in order to provide space for the print which receives the cope. The cope machine, Fig. 2, carries a metal pattern, which is so constructed that it may be rolled down away from the sand by means of a hand lever. The form of the cope is clearly shown in this illustration. It is so made that it fits snugly into the print formed in the top of the drag, thus obviating the necessity of flask clamps or pins of any sort. The green sand core which hangs down from the cope is held in place by curved fingers which act like gaggers.

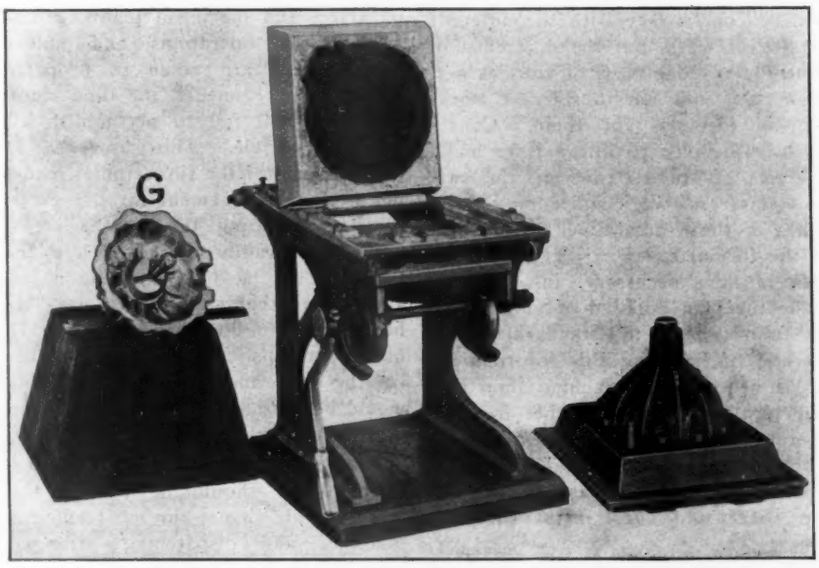


FIG. 2—COPE MACHINE, WITH DRAG PATTERN AT THE RIGHT AND DRAG WITH CASTING AT THE LEFT

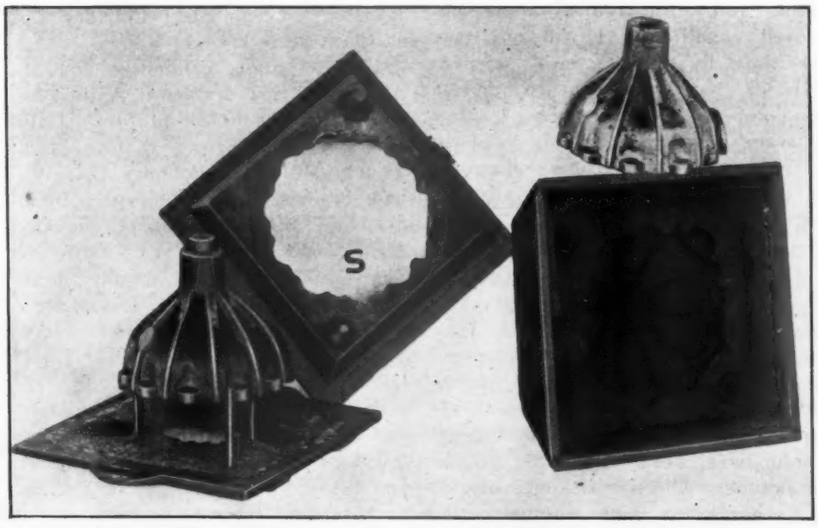


FIG. 1—DRAG MOLD, PATTERN, STRIPPING-PLATE AND CASTING

Molding the Drag

In molding the drag, the stripping plate *S*, Fig. 1, is set in position so that it rests on the follow-board and fits snugly around the pattern. The drag, which fits over the tapered shoulders of the stripping plate, is held in position by a couple of simple clamps. With the flask in place, the sand is rammed around the pattern, care being taken to tuck it properly between the ribs, after which the drag is rolled over and the pattern

drawn out through the stripping plate. The plate itself is then removed, leaving a tapered print in the drag to receive the cope, as shown in Fig. 1.

The cope is molded by placing the arbor which holds the sand on the machine, ramming the mold and drawing the pattern with the hand lever. The hole through the hub of the casting is formed by a cylindrical dry sand core, which is held in place by prints in the cope and drag.

The cope fits so snugly into the drag mold that there is no danger of shifting. The metal is poured through a single runner, which passes down through the green sand core, terminating in a three-way gate, shown at *G*, Fig. 2. One man is employed to work the cope machine and another to make the drags, which are molded on a bench. The average production of the two men is said to be 160 molds per day. Seventy molds per day is understood to be the best production obtained by hand methods.

Economies in the Manipulation of Sand†

By A M Thompson*

COMPARATIVELY few years have passed since cores were made entirely of new sand. The introduction of new kinds of binders and sand mixing machinery, in recent years, has brought about a condition in some shops whereby all of the core sand may be used indefinitely, with only sufficient new sand added to take care of the waste.

As an illustration of this, some years ago in the foundry of H. W. Caldwell & Son Co., Chicago, the formula for core sand for arm cores, for wheels or pulleys, rim cores, etc., consisted of 80 per cent new sand and 20 per cent old sand. This large percentage of new sand necessitated hauling the cores out to the dump pile after they were knocked out of the castings, and paying money for getting them hauled away. The amount of new sand has been gradually reduced and gangway and old core sand increased until the formula now used, is 20 per cent new sand and 80 per cent old sand, this amount of new sand being necessary to give body to the mixture.

For green sand facing, we are using one-third new molding sand, one-third heap sand and one-third old cores which have been crushed in a cinder mill. These mixtures are prepared in a sand mill in the following manner: The heap sand and core sand is shoveled into the mill, then the new molding sand and seacoal or core compound, as the case may be, are added, there being altogether about four cubic feet of sand. The mill is then set in motion and in five minutes the sand has been thoroughly incorporated and not a vestige of the new sand can be detected, the mixture being absolutely black in color.

The action of the mill is to squeeze the old sand into the new sand and separate the clay grains so that by the time the operation is finished the light colored new sand has entirely disappeared, or in other words, is completely dissolved. If the mill is allowed to run longer, the sand gets tough and is in better shape for gear teeth and deep-lifts. Sand, which if mixed by the ordinary processes of shoveling and riddling would have no bond and would be unsatisfactory for facing, can be made as strong or tough as desired.

The economies consist of labor saved in the mixing processes and the employment of a cheaper grade of new molding sand. If we assume that a happy combination of the principal elements of silica and alumina are all that is required to make good sand, we may take sands which in their natural state are difficult to work or incorporate by the ordinary processes and by the use of sand mixing machinery, prepare them at small cost for the various uses in the foundry. The accompanying tables show what can be saved in a shop employing 25 or 30 molders by incorporating a large amount of old sand in the mixtures. The difference in the cost per ton shown in Table II is largely due to the possibility of using a cheaper grade of new sand in the mixing machine.

By mixing core oil sand in a machine, a smaller quantity of oil is required to give the same bond to the sand. The ratio when mixing by shovel and riddle was 1 to 45, while mixing by machine it has been reduced to 1 to 60. The difference amounts to 25 per cent and a foundry using a 50-gallon barrel of oil a month would save $5 at 40 cents a gallon. This, added to the savings shown in Table I and Table II, would give a total saving of $1,267 a year in a shop employing 25 to 30 molders. To this may be added $300 a year saved in the labor of mixing.

Table I.
HOW THE USE OF OLD MOLDING SAND SAVES MONEY

Formerly Used	
40 per cent or 800 pounds of new molding sand at $1.20 per ton	$0.48
40 per cent or 800 pounds of sharp sand at 60c per ton	.24
20 per cent or 400 pounds of old core or gangway sand	...
1 to 40 or 50 pounds of compound, $30	.75
Cost per ton	$1.47
Now Used.	
20 per cent or 400 pounds of new molding sand at $1.20 per ton	$0.24
80 per cent or 1,600 pounds of old core sand	...
1 to 80 or 25 pounds of compound at $30 per ton	.38
Cost per ton	$0.62
Difference in cost per ton	$0.85

Table II.
FACING SAND MIXTURES

Formerly Used	
1/3 or 666 pounds new molding sand at $2.35 per ton	$0.78
1/3 or 666 pounds heap sand	...
1/3 or 666 pounds heap sand or old core sand	...
1 to 10 or 200 pounds of sea coal at $7 per ton	.70
Cost per ton	$1.48
Now Used	
1/3 or 666 pounds of new molding sand at $1.20 per ton	$0.40
1/3 or 666 pounds of heap sand	...
1/3 or 666 pounds of heap sand or core sand	...
1 to 10 or 200 pounds of sea coal at $7	.70
Cost per ton	$1.10
Difference in cost per ton	$0.38

†The paper was presented at the April meeting of the Chicago Foundrymen's Club.

*Superintendent of H. W. Caldwell & Son Co.'s foundry, Chicago.

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Contents

	PAGE
How Stove Plate is Molded on Squeezers	165
Will Make Foundry Rigs	168
How to Make Your Time Studies Accurately	169
New Castings Plant in the Automobile City	175
Expansion of Cast Iron	177
The Production of Gold Finishes	178
Tropenas Converter Versus Electric Furnace	180
From the Seat of the War in Mexico	182
Making, Molding and Casting Large Flywheels	183
How to Prevent Pattern Shop Accidents	189
Melting Bronze in a Cupola	193
Matching Color of Castings	193
How to Use Aluminum Solder	193
German Silver Difficulties	193
Mixture for Carburetor Castings	194
Equal Parts of Copper and Lead	194
Coke for Crucible Melting	194
Mixture for Driving Brasses	194
Acid-Resisting Bronze	194
Local Committees for Chicago Convention	195
Rig for Molding Automobile Gear Cases	196
Economies in the Manipulation of Sand	197
Molding Machine Auxiliaries	198
Trade Outlook	198
Twin-Table Molding Machine	199
Combination Spray Can and Mold Dryer	199
New Combination Molding Machines	199
Portable Radial Swing Grinder	200
The Arcade Spring Sprue	201
Book Reviews	201
Willson Company Expands	202
Portable Electric Tools	202
Southern Michigan Foundrymen's Association	202
Personals	202
How to Figure Silicon	203
General Industrial Notes	203
New Trade Publications	204

Molding Machine Auxiliaries

To realize the utmost from the introduction of machine molding, it is necessary to have every department in the shop properly co-ordinated so that the increased production possible through the use of machines will not be dissipated. This is a point that superintendents and foremen sometimes overlook, with the result that the machines fail to do what was expected of them. In such cases the machines are blamed when the fault lies in the organization of the shop. It is not sufficient to simply set up the machine beside a sand heap and expect the output to be doubled. The machine must be supplemented by suitable auxiliary apparatus which will enable it to be operated continuously at the limit of its capacity. Frequently it is discovered after molding machines have been introduced in a shop that the sand-handling facilities are unequal to the new situation; on the other hand, the cleaning room may be found to be insufficiently equipped or some other department may be undermanned. As pointed out in the leading article in the April issue of THE FOUNDRY, a Wisconsin manufacturer of agricultural implements found that he was not getting the proper results from his molding machines because the men could not pour off the maximum machine production by hand. This foundryman solved the problem by inventing a device which relieves the molder of the labor of pouring. As a consequence, his machine output increased 20 per cent. An article in this issue points out how another foundryman increased his output of stove plate by fitting up the machines with aluminum match plates. In each of these cases the purpose of the auxiliary apparatus was to keep the work of every other department in step with the molding room, so that the machines could turn out their maximum production. Idle molding machines are a liability, not an asset.

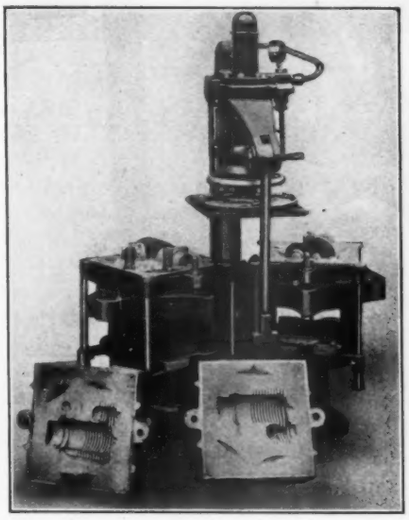
Trade Outlook

During April the foundry trade marked time in most centers, although at the present writing the clouds that envelop the general business situation show some signs of moving away. Railroad buying remains at a low ebb and as a consequence malleable and heavy steel foundries are operating with greatly reduced forces. Foundries turning out small steel castings and specialty shops are doing fairly well. Many foundrymen are taking advantage of favorable prices and labor conditions to make repairs and improvements to their plants and the manufacturers of foundry and shop equipment are, therefore, enjoying fairly liberal orders. Scrap prices remain low and the old material market is demoralized. Some foundrymen are quietly buying stocks at low prices. No. 1 cast is quoted $9.50 a net ton at Chicago and $10.00 at Cincinnati. At Pittsburgh No. 1 cast is $12.00 a gross ton. Pig iron prices remain fairly firm largely because they are near the cost line. Pig iron output in March gained 450,000 tons over February, but most of the increase was due to blowing in steel works furnaces. Merchant production shows but little tendency to increase. At the same time, shipments are going forward to the foundries freely and comparatively little iron is accumulating in furnace yards. In the leading centers No. 2 foundry iron is quoted as follows: Chicago, local, $14.25; Cleveland, $14.00; Pittsburgh, $14.15; Buffalo, $13.50; Philadelphia, $14.80, and Birmingham, $10.75. Lake Superior charcoal, Chicago, is $15.50 and malleable is quoted $14.25, Chicago, and $13.50, Buffalo.

New Equipment for the Foundry and Pattern Shop

Twin-Table Molding Machine—Spray Can and Dryer—Combination Molding Machine—Swing Grinder — Spring Sprue

An exceedingly ingenious hydraulic molding machine, equipped with twin tables, has been built by Ph. Bonvillain & E. Ronceray, Paris, for molding motorcycle engine cylinders. As shown in the accompanying illustration, it will be noted that both cope and drag are made on this machine in separate operations. This, however, requires the work of one man only, inasmuch as in making one part of the mold he merely swings the head of the molding machine over the pattern plate and for the other half he performs a similar operation as for the previous half. In designing this machine for this work it was pointed out that it is much more desirable to employ one man on work of this kind than possibly an operator and a helper, owing to the fact that these castings must be carefully made and if poor work results, the blame readily can be located. No foundation is required for the tables, which are supported by the floor of the foundry, and this permits of their easy removal when necessary.



FRENCH MOLDING MACHINE EQUIPPED WITH TWIN-TABLES FOR MOLDING COPE AND DRAG

Combination Spray Can and Mold Dryer

A new device for foundry use, which is being introduced to the trade by W. A. Roedell, 614 Ocean avenue, Jersey City, N. J., is a combination spray can and mold dryer which can be used for drying and spraying blacking on molds and cores. The outfit consists of a spray can, which is filled with blacking for spraying and either fuel oil or kerosene for drying, an igniter horn and an air valve attached to a hose from the compressed air main. In addition, the spray can is equipped with an oil valve and the igniter horn is provided with an oily waste basket. Into this basket is placed a small piece of oily waste, which is lighted when the outfit is to be used for molds or cores. For lighting cupolas and drying ladles a somewhat larger outfit is provided and being portable, it can be set in front of the cupola or carried to the ladles which are to be dried.

In Fig. 1 is shown a mold for a large pipe made at the plant of the Gibson Iron Works Co., Jersey City, N. J. The molder is shown spraying blacking with one of the combination outfits, while in Fig. 2 the same device is being used for drying the mold. In Fig. 3 blacking is being sprayed onto the core for this mold. A hose is connected to the device leading from a compressed air line.

The cupola lighter, or mold dryer, is a self-contained outfit and can be used to advantage in foundries not equipped with an air compressor plant. In addition to drying molds and lighting cupolas, this kerosene hand pump torch can be utilized for making repairs to castings by the burning-on process. This torch eliminates the use of charcoal baskets, metal plates, etc., in drying molds and can be employed for other purposes throughout the plant, such as thawing-out turntable tracks and switches in winter time, heating or bending iron pipe or heavy bars, brazing and tempering tools and for heating iron in boiler shops.

New Combination Molding Machines

Two molding machines designed by the S. Freeman & Sons Mfg. Co., Racine, Wis., are shown in the illustrations on the following page. Fig. 1 illustrates a combination stripping plate and roll-over machine, while Fig. 2 shows a special hinged roll-up machine. The machine illustrated in Fig. 1 is used principally for molding light

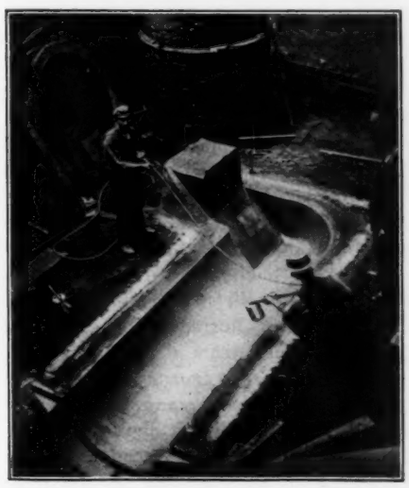


FIG. 1 — SPRAYING BLACKING ON A LARGE PIPE MOLD

FIG. 2.—DRYING THE MOLD WITH SPECIAL TORCH

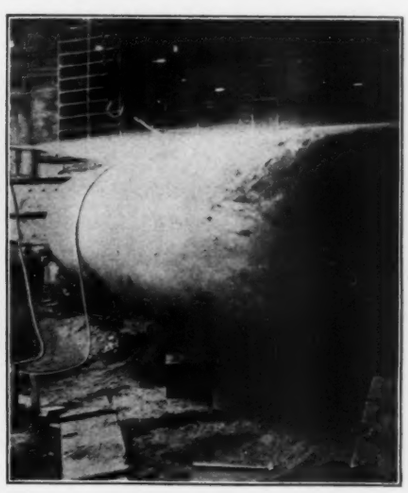


FIG. 3—SPRAYING BLACKING ON A CORE

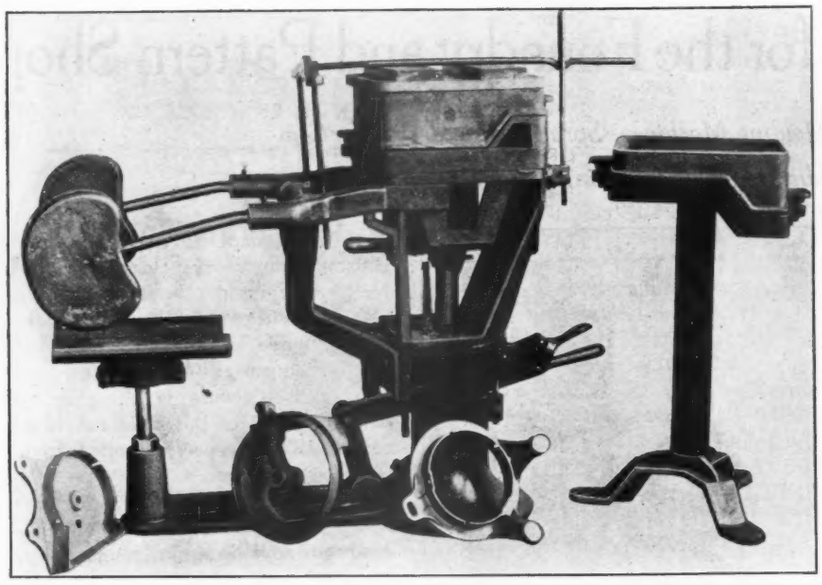


FIG. 1—COMBINED, COUNTERWEIGHTED ROLL-OVER STRIPPING PLATE MACHINE

agricultural castings and some samples of the work turned out may be seen leaning against the base of the machine. The stripping mechanism, which is operated by the heavy lever shown at the right, is counterbalanced with large adjustable weights so that it may be operated easily. The drag portion of the mold, which is made on the machine, is rolled-over after the pattern has been stripped out. An automatic cleat adjustment for the bottom board is not necessary, inasmuch as the pattern is out of the way when the mold is turned over and it makes no difference whether all four corners of the bottom board touch the flask or not. The cope, which is nothing more than a dummy containing the runner, is rammed on the special stand shown at the right in Fig. 1.

The machines shown in Fig 2 are designed to mold intricate, light agricultural castings, samples of which are shown in the foreground between the flasks. The drag machine is illustrated at the right and the cope machine at the left. The former contains a stripping plate attachment for drawing that portion of the pattern which forms the ends of the castings. After the end pieces are stripped out, the drag is rolled-over and deposited on the receiving chair shown at the extreme right.

The cope has a special shape and is provided with two bars for holding the sand in place. The pattern is hinged out of the sand precisely as a hinged match-plate is operated. This type of machine is specially useful for molding a large variety of flat, thin work.

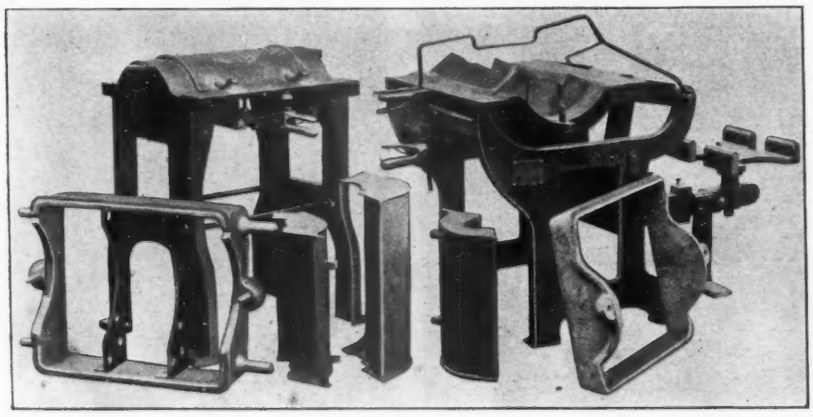
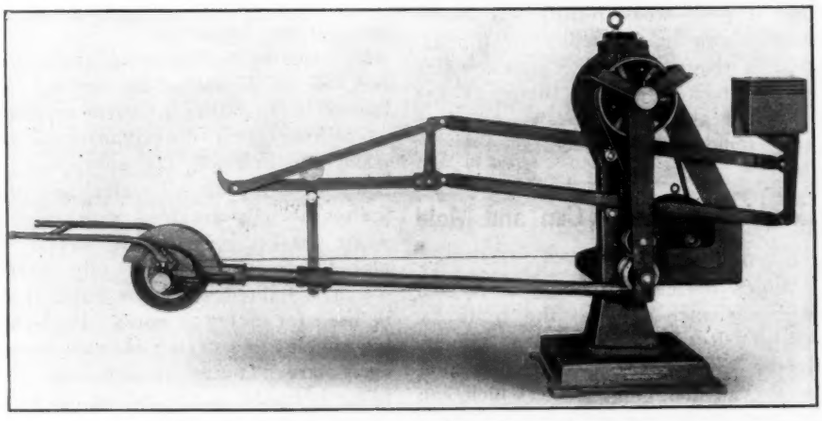


FIG. 2—SPECIAL STRIPPING AND ROLL-OVER MACHINE WITH HINGED COPE ARRANGEMENT

Portable Radial Swing Grinder

A portable swing grinder of a new type, designed to be handled by traveling cranes recently has been placed on the market by the Mummert-Dixon Co., Hanover, Pa. The machine is built for grinding large and medium-sized castings and doing other general buffing work. It will do the same work as a stationary swing grinder, but with the added feature of portability. The machine is self-contained, and is driven by a motor mounted on a suitable platform which is a part of the main housing. The counterbalance for the swinging arm and grinding head also is mounted on the main housing. The arm with the grinding head can be turned through an entire circumference about the base of the machine.



PORTABLE, MOTOR DRIVEN SWING GRINDER

Its portability permits the machine to be carried anywhere by the traveling crane and placed convenient to the work. The top of the pedestal is provided with a heavy eye into which the crane hook fits. The grinding head and the swinging arm are carried back and forth by a roller bearing trolley which runs on a track held in horizontal position by two parallel arms. The counterweight is placed at the rear end of these arms. This arrangement, which is sometimes called a paradox lever, is said to keep the head properly balanced at all positions of the trolley. It is meant to give a free and even movement to the swinging arm

and eliminates the tendency of the arm, with its weight, to seek its center of gravity.

The grinding head can be twisted in either direction, right or left, through an angle of 90 degrees. This feature is of special service in grinding the sides of castings. The grinding wheel is driven by a single belt which is carried around the jointed connection of the swinging arm and hanging swing frame by two self-oiling idler pulleys. The large pulley at the top of the pedestal is driven by a shaft to which a drive pulley on

FIG. 1—ARCADE SPRING SPRUE

the inside of the housing is keyed. The motor is belted to the drive pulley.

The wheel in the grinding head is shielded by a hood over the top. Handles are attached to the head for the convenience of the operator. The wheel arbor runs in phosphor bronze bearings with suitable provision for taking up the wear. It has safety flanges and will take a wheel 18 inches in diameter and with a 3-inch face.

The machine is mounted on a substantial base which supports a vertical pedestal. The main frame or housing is mounted on the latter. A strong bracket on the side of the housing carries the swing frame to which the grinding head is attached.

The Arcade Spring Sprue

As squeezer ordinary machines are operated, it is necessary to cut the sprue holes with a sprue cutter after the mold has been rammed, as it is impossible to use a wood sprue. To obviate this extra labor, the Arcade Mfg. Co., Freeport, Ill., has developed a spring sprue which is illustrated herewith. Its use eliminates the work of cutting the sprue hole after the mold is rammed. The mold is rammed and the sprue hole cut at one operation. When the mold is squeezed the head of the spring sprue is pressed down level with the upper surface of the sand. When the pressure is relieved the head springs back so that the operator can instantly remove the sprue. The device consists of a bell-shaped base with a suitable cavity for holding the spiral spring and guiding the sprue in its vertical movements. The spring sprue can be used with gated patterns or squeezer plates.

Book Reviews

The Steel Foundry, by John Howe Hall; 271 pages, illustrated, published by McGraw-Hill Book Co., New York, and furnished by THE FOUNDRY for $3 net.

This book covers the metallurgy of the steel foundry from the point of view of the engineer, metallurgist and executive. The book covers the various classes of steel castings that are in demand today, and their characteristics from a manufacturing point of view. The types of steel-making processes that are in use and their essential features, such as relative cost of installation, relative cost and quality of steel produced, are also described. In addition, the book outlines the conditions which govern the adoption of the proper melting process in a specific case. General shop procedure is also fully covered including molding, pouring, core making, annealing, pattern-making, etc.

The volume is written to interest not only steel foundry metallurgists and superintendents, but also the managers, officers and stockholders of existing or projected foundries. The cost data found in the introductory chapter will be of special interest to persons who contemplate embarking in steel foundry business. Special chapters are devoted to descriptions of the crucible process, the Bessemer process, the open-hearth process and electric methods of melting steel for castings. The remaining chapters cover the subjects of molding, pouring and digging out; heat treatment and annealing; finishing, straightening and welding; laboratories and impurities in steel.

The Efficient Man, by Thomas D. West; 330 pages; illustrated, published by Thomas D. West, Cleveland, Ohio, and furnished by THE FOUNDRY for $2 post paid.

As the title indicates, this book aims to present a philosophy of life with special reference to the training necessary to develop the proper qualities of leadership in superintendents, managers and other executives

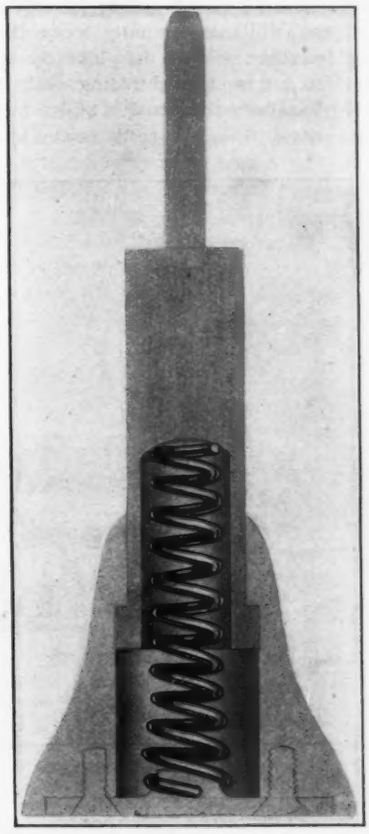


FIG. 2—VERTICAL SECTION OF SPRUE, SHOWING SPRING

in industrial establishments. The author points out that the employees in a shop often have more influence on the cost of the product than any labor-saving machinery that could be introduced.

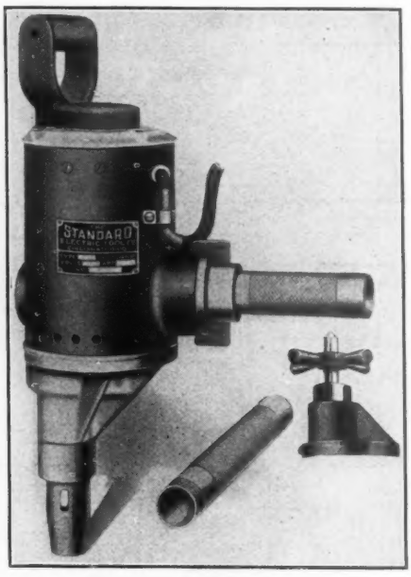
It is therefore necessary that the employees, particularly the apprentices, be properly and carefully trained. Mr. West points out that what we need today is men who combine practical shop knowledge with financial and executive ability.

The book, which is profusely illustrated by drawings and cartoons, is divided into three parts. The first part treats of the intellectual requirements, the education and special training necessary to develop industrial

leadership. Part two discusses the general problems of shop supervision, while part three treats of labor-saving management, disciplining men and the individual qualifications necessary in establishing a new business. A supplement to the book contains an excellent biography of the author.

Willson Company Expands

T. A. Willson & Co., Inc., Reading, Pa., manufacturers of goggles, eye protectors, spectacles, etc., have acquired additional property for extensions to their plant. About four years ago the Willson company more than doubled the size of its plant by the erection of a new building, but so rapid has been the growth of its business that it was forced to build a



PORTABLE ELECTRIC DRILL

small addition this year and to take steps to provide ample space for further expansion. This company now has in successful operation a system of profit-sharing in which the heads of all the departments are included, and a weekly paper is issued entitled "Between Friends", which is distributed to all of the employes.

The Cleveland Blow Pipe & Mfg. Co., Cleveland, recently has issued two interesting booklets, one devoted to dust-collecting systems for emery, buffing and polishing wheels, grinders, emery belts and other dust-producing machinery. Various types of hoods are illustrated. Another booklet is devoted to this company's vacuum ventilator, which is adapted for installation in all industrial plants.

Portable Electric Tools

A line of ball bearing, portable electric grinders and drills has recently been placed on the market by the Standard Electric Tool Co., Cincinnati. They are designed to operate on both direct or alternating current up to 60 cycles and are arranged specially to meet the demand for grinders that will run satisfactorily on 25, 30 or 40 cycle circuits. The spindle speed is approximately 6,000 revolutions per minute, the motors being rated at 1/6 and ¼-horsepower, depending upon the class of work to be performed. The drills are built in two sizes, ⅝-inch and 1-inch capacity. The motors are form-wound and their coils are impregnated with an insulating compound designed to prevent grounds, short circuits and other troubles incident to high-speed apparatus. The tools are built on the unit plan which tends to make them easily accessible. All of the electrical connections are made in the frame unit.

Southern Michigan Foundrymen's Association

Foundrymen operating plants in southern Michigan gathered at the Commercial Club, Kalamazoo, on March 28 and organized the Southern Michigan Foundrymen's Association. David McLain, Goldsmith building, Milwaukee, delivered an address on "Semi-steel", which was followed by a business meeting. The following officers were elected:

President—D. A. Williston, Albion, Mich.

Vice President—C. E. Anderson, Vicksburg, Mich.

Secretary-Treasurer—S. A. Schaeffer, Kalamazoo, Mich.

It is the intention of this organization to hold monthly meetings, which will be addressed by prominent men in the foundry trade.

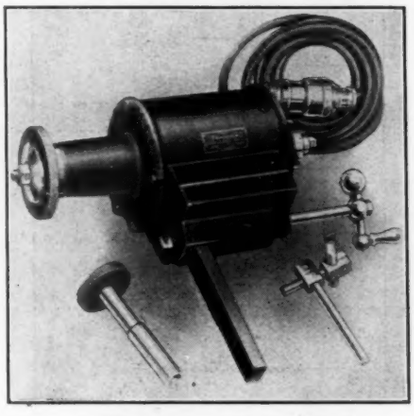
At the recent annual meeting of the Murphy-Potter Co., Detroit, the firm name was changed to the Brass & Aluminum Foundry & Machine Co. William E. Campbell, who has been sales manager during the past three years, has been appointed general manager. The company specializes in bronze shell, babbitt-lined bearings, geared circulating pumps for oil and water, carburetors, etc., as well as brass and aluminum castings.

The St. Louis Frog & Switch Co., St. Louis, will erect a foundry for the manufacture of manganese steel castings to consist principally of frogs, switches and special work for electric railways. The contracts for the buildings already have been awarded, but the company will purchase considerable new equipment. The contract for the grinding machinery shortly will be awarded.

Personals

A. S. Baldwin, formerly general manager of the Alberger Pump & Condenser Co., Newburgh, N. Y., has accepted the position of manager of works of the Best Mfg. Co., Pittsburgh. Mr. Baldwin also formerly was general superintendent of the Driggs-Seabury Ordnance Corporation, Sharon, Pa.

At a recent meeting of the board of directors of the Yale & Towne Mfg. Co., New York City, Walter C. Allen, general manager, was elected vice president. Mr. Allen has been



PORTABLE ELECTRIC GRINDER

affiliated with the Yale & Towne Mfg. Co. since 1891, and has served in various capacities, his election as vice president being significant recognition of his successful discharge of the responsibilities entrusted to him.

Carl H. Booth, one of the partners of the Shuman-Booth Co., Chicago, has retired from that firm, and now is affiliated with the Metallurgic Engineering Co., 1660 Monadnock building, Chicago. Mr. Booth was elected vice president of this company, and will devote his entire time to the sales end of the business. The Metallurgic Engineering Co. builds and installs electric furnaces for use in foundries and steel plants.

The Beach Foundry Co., Ltd., Ottawa, Can., has acquired the plant of the Butterworth foundry of that city. This company makes a specialty of stove castings.

How to Figure Silicon

By W. J. Keep

Question.—On page 422 of the October, 1913, issue of THE FOUNDRY you explained the method of figuring the percentage of silicon in a mixture. However, I make this estimate on a different basis and would like to know which is correct. My method of procedure follows: Our charge consists of 1,200 pounds of iron, 360 pounds of which contains 3.52 per cent silicon, which constitutes 30 per cent of the mixture; 120 pounds containing 2.78 per cent silicon, which is 10 per cent of the mixture; 120 pounds containing 3.22 per cent silicon, which is 10 per cent of the mixture; 60 pounds contain 3.05 per cent silicon, which is 5 per cent of the mixture; 60 pounds containing 2.58 per cent silicon, which is 5 per cent of the mixture, and 480 pounds of sprues containing 3.10 per cent silicon, which is 40 per cent of the mixture. As 360 pounds of pig iron is 30 per cent of the mixture and contains 3.52 per cent silicon, it thus will have 1.056 per cent silicon. The other silicon contents in order and in percentages follow: 0.278, 0.322, 0.1525, 0.129, 0.24. The total is 3.1775, and allowing for 0.25 per cent loss, the silicon in the iron will be 2.9275 per cent.

Answer.—Your method of figuring the silicon is correct, but the usual system employed follows:

Pounds of iron.		Per cent silicon.		Pounds silicon.
360	×	3.52	=	12.672
120	×	2.78	=	3.336
120	×	3.22	=	3.864
60	×	3.05	=	1.830
60	×	2.58	=	1.548
480	×	3.10	=	14.880
1,200				38.130

1,200)38.130

0.031775
or 3.1775 silicon
0.25 loss

2.9275 per cent silicon in the mixture.

The results are identical and the number of figures required to solve the problem are the same. The latter method is the one generally employed and is most easily understood. In view of the fact that the chemist writes 0.0352 3.52 per cent and 0.30, 30 per cent, it will be necessary to change the decimal from 0.0352 to 3.52, or you can make the changes at the end of the computation.

Making, Molding and Casting Large Fly Wheels

(*Continued from page* 188)

ner for pouring and *S* also is used for the same purpose, or alternately as a riser from the hub; *T-T* are the risers off the top face and which, as already mentioned, are distributed around the face for feeding purposes. The hub core, *D*, is placed into position before lowering the top part into place which is defined by the register. The staples, as shown, are cast into the top plate, being required for lifting purposes. The surfaces of the complete mold are blackwashed, and after assembly, both parts are bound together by means of hook bolts, or tie bars passing through each top and bottom building plate. The whole is then lifted and pit-rammed for casting, feeding heads being made up where required as in the previous examples.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Elyria Foundry Co., Elyria, O., has increased its capital stock from $50,000 to $75,000.

Fire recently damaged the foundry of F. N. Cooper & Co., Harrisburg, Pa., to the extent of $4,000.

The Chicago Car Wheel & Foundry Co., Chicago, has filed formal notice of its dissolution.

Operations have been commenced in the new plant of the Calhoun Foundry Co., Anniston, Ala.

The Brunner Foundry & Machine Co., Peru, Ill., has been sold to Peru and La Salle investors for approximately $65,000.

The Star Brass Works, Seattle, Wash., has been incorporated with $6,000 capital by M. O. Stone and M. W. and E. Ryan.

The Ferro Machine & Foundry Co., Cleveland, has increased its capital stock from $600,000 to $850,000 to provide more working capital.

Ernst Arnold, operating the Progressive Copper & Brass Works, 325 Bingaman street, Reading, Pa., has added a brass shop to his foundry.

Fire slightly damaged the plant of the Germania Supply & Foundry Co., Covington, Ky., recently destroying about $2,000 worth of patterns.

The Beach Foundry Co., Ltd., Ottawa, Can., has acquired the plant of the Butterworth Foundry Ltd. A specialty is made of stove castings.

The Commercial Foundry Co., Los Angeles, Cal., has been incorporated with a capital of $15,000 by William Sharpe, S. G. Lowe, Guy Downing and Albert Jones.

The Wabash Foundry Co., Wabash, Ind., has been incorporated with a capital of $50,000 by Nelson G. Hunter, James I. Robertson and Charles H. Haas.

Fire a short time ago, in the foundry of the S. Morgan Smith Co., York, Pa., destroyed valuable patterns and equipment. The loss is approximately $10,000.

The Pierkle Foundry Corporation, Queens, New York City, has been incorporated with $25,000 capital by Hyman Youdelmon, G. L. Schepf and William Bogen, 38 White street, New York.

The C. J. Rath Brass & Aluminum Co. has completed a plant at New Philadelphia, O., for the manufacture of brass and aluminum castings and a specialty will be made of parts for vacuum cleaners.

The Reliance Foundry Co., Richmond, Ind., has been reorganized. George L. Schultz has retired as treasurer, Vice President J. E. Jones taking up his duties. Edward I. Hunt is president and Howard C. Hunt, secretary.

The foundry of Joseph Duncan & Son, manufacturers of mining machinery, Lykens, Pa., was burned recently with a loss of $25,000. Patterns over 50 years old were destroyed and some cannot be replaced. The foundry was one of the oldest in Dauphin county.

George F. Crivel & Co., Buffalo, recently incorporated, will manufacture a complete line of foundry facings and supplies and also will represent the Whiting Foundry Equipment Co., Harvey, Ill., in the Buffalo territory. George F. Crivel is president, William Dodge, vice president and L. M. Dentinger secretary and treasurer.

The Hodgson Foundry Co., 2012-2018 West Thirteenth street, Chicago, recently moved into its new building and has added a large amount of new equipment. The former foundry operated by this company will be devoted exclusively to the manufacture of copper and bronze castings for blast furnaces and will be in charge of J. M. Palmer, who for a number of years was affiliated with the Best Manufacturing Co., Pittsburgh.

The American Sand Blast & Machine Co., Chicago, has been incorporated with $25,000 capital to succeed the American Sand Blast Machinery Co., a co-partnership. At present its foundry, structural and sheet metal work is being done by contract and the sand blast machinery and appliances manufactured by this company are erected in an assembling plant on Canalport avenue. The offices are located at 1535 Lytton building, Chicago.

New Construction

The American Car & Foundry Co., Berwick, Pa., will erect an addition to its plant to cost $60,000.

The Kansas City Malleable Iron Co., Kansas City, Kan., is building a one-story foundry, 70 x 200 feet.

The Self-Oiling & Bearing Co., Walla Wal-

la, Wash., will erect a foundry and machine shop which will cost $25,000.

White Bros., Inc., Philadelphia, will erect a $3,500 foundry at Hedley & Carbon streets.

The Two Rivers Plating Works, Two Rivers, Wis., will erect an addition and install new plating and electrical equipment.

The Bay View Foundry Co., Sandusky, O., will erect a steel, concrete and brick building, 200 feet square and one story high.

Reese & Strong, Columbus, O., recently organized to manufacture foundry specialties, will erect a 60 x 100-foot foundry shortly.

The Plymouth Foundry & Machine Co., Plymouth, Wis., manufacturer of power farm machinery, will erect a two-story brick addition, 60 x 136 feet.

The Tampa Foundry & Machine Co., Tampa., Fla., will build a one-story, 50 x 60-foot steel and wood addition to its plant to cost approximately $12,000.

Manning, Maxwell & Moore, who have taken over the Putnam Machine Co., Fitchburg, Mass., will erect a machine shop, foundry and several other buildings.

The Kienzle & Merrick Mfg. Co., Minneapolis, Minn., manufacturer of brass and iron goods, has let the contract for its proposed plant to W. H. Arrell & Co.

Plans are ready for a proposed foundry to be erected at Grafton, W. Va. O. A. Heffner, Grafton; and John H. Mayselles, of Michigan, are backing the proposition.

The Pittsburgh Foundry & Machine Co., Pittsburgh, has purchased about 44,000 square feet of property fronting on Thirty-sixth street and the Allegheny river. A foundry will be erected.

The Superior Foundry Co. has broken ground at Bessemer, Ala., for its $65,000 plant. Officers are as follows: President, Wiley Alford; vice president, W. C. Martin; secretary and treasurer, M. Shook; manager, John Birdwell.

The Adrian Steel Casting Co., Adrian, Mich., has added a new department for making concrete block machinery. The company also has increased its capital stock from $30,000 to $40,000 and will build a machine shop, 50 x 100 feet, of concrete block.

The Taylor-Wharton Iron & Steel Co., High Bridge, N. J., will erect an extensive plant at Easton, Pa. The buildings will include a foundry, 130 x 464 feet; machine shop, 300 x 400 feet; grinding shop, 120 x 400 feet; blacksmith shop, 110 x 320 feet; pattern shop, 120 x 200 feet; two pattern storage buildings, each 50 x 120 feet; power plant, office and auxiliary structures. Westinghouse, Church, Kerr & Co., 37 Wall street, New York City, are the engineers in charge and are taking bids.

The Dresser Engine & Foundry Co., Oil City, Pa., has been formed by merging the Oil City Foundry Co. and the Flickinger Iron Works, Bradford, Pa. Gas engines, air and gas compressors will be manufactured and gray iron castings also will be furnished to the trade. The new company will erect a machine shop, 75 x 200 feet, and will purchase some machinery. It also will erect a pattern storage, about 40 x 100 feet. Robert A. Dresser is president and manager; Richard P. Morgan, vice president, and Richard S. Lynam, secretary and treasurer.

Among the Brass Founders

The National Aluminum & Bronze Mfg. Co., Indianapolis, has been dissolved.

The Rempis & Gallmeyer Foundry Co., Grand Rapids, Mich., will build a large brass foundry.

The Bunting Brass & Bronze Co., Toledo, O., has increased its capital stock from $50,000 to $100,000.

The Gross Mfg. Co., Hazelton, Pa., will rebuild its brass foundry which was damaged by fire recently.

The Mueller Brass Co., Sarnia, Ont., will enlarge its plant and install new steam hammers, molding and tool making equipment.

The Hudson River Foundry Co., Poughkeepsie, N. Y., has resumed operations in its brass foundry, which has been idle for some time.

The Lorain Brass & Bronze Foundry Co., Lorain, O., has been incorporated by E. M. Cable, William H. Harding, Joe Finegold and A. H. Gabriel.

The Reline Metal Co. has been organized to take over the brass and aluminum foundry at Norfolk Downs, Mass., formerly operated by Swan & Swangren.

The Federal Brass Mfg. Co., Cleveland, has been incorporated by R. H. Hunger, M. A. Neipert, W. H. Nye, D. M. Targer and M. A. Clancy to manufacture brass goods.

The Ajax Brass Mfg. Co., Chicago, has been incorporated with a capital of $10,000 to operate a foundry. The incorporators are J. F. Lockrey, C. A. Soans and A. H. Graves, 53 West Jackson boulevard.

The Waterloo Brass Foundry Co., Waterloo, Ia., has been incorporated with a capital of $10,000 to engage in the manufacture of brass, copper and aluminum castings. The incorporators are B. Schultz, Harry E. Cohn, Henry L. Wheelock and Jacob Cohn.

The Wolverine Brass Works, Grand Rapids, Mich., is remodeling its boiler house and installing an auxiliary plant to furnish steam heat and water when the power plant is not running. Equipment has been purchased. The company manufactures plumbing specialties.

The Wambold Mfg. Co., brass founder, Milwaukee, has been placed in the hands of a receiver. The schedules show liabilities of $12,594 and assets of $50,051. Harry E. Wambold, manager of the defunct company, at the same time filed a voluntary petition in bankruptcy. His liabilities are $8,629 and assets $18,738, of which $17,000 is represented by Wambold Mfg. Co. stock shares.

The North West Aluminum & Brass Foundry Co., Rochester, N. Y., recently incorporated with a capital of $5,100, has built a new foundry at 14 Riley place, 50 x 100 feet. The company manufactures all kinds of aluminum, brass, bronze or other castings not including iron, John R. Loysen, George A. Hetzler and Charles Tepper, who are running the business, have been engaged for 30 years in the foundry trade, formerly having been interested in the Sill Stove Works, Rochester. The company advises that if the present demand for castings continues, it will be necessary to build extensions on a site adjoining, which it now controls.

NEW TRADE PUBLICATIONS

WELDING AND CUTTING APPARATUS.—A 16-page catalog issued by the Waterhouse Welding Co., Boston, is devoted to its line of equipment for welding castings and for cutting steel. The outfit is of the acetylene type and can be furnished in various sizes to meet different requirements of the trade.

ELECTRIC CONTROL SYSTEMS. — The Sprague Electric Works of the General Electric Co., New York City, has issued a 32-page catalog devoted to electric control systems especially applicable to newspaper and rotary magazine presses. The catalog is well illustrated and shows numerous installations of this control apparatus.

ELECTRIC DRILLS AND GRINDERS.—Two bulletins issued by the Chicago Pneumatic Tool Co., Chicago, are devoted to this company's line of electrical drills and grinders. An electric sensitive drilling stand also is shown, which is built in five sizes to take the standard Duntley side spindle drills of either the universal or direct current types, ranging in drilling capacities from 3/16 to 1/2 inch in metal.

INDUSTRIAL PLANT EQUIPMENT.—Wonham, Sanger & Bates, Inc., 30 Church street, New York City, in a loose-leaf catalog containing 16 pages and which is to be amplified with future bulletins, illustrate and describe the equipment which they handle including light locomotives, cranes, portable tracks, turntables, dump cars and buckets, hoists, traveling cranes, sand mixing machines, fire brick, etc.

FOUNDRY EQUIPMENT.—An exceedingly comprehensive catalog, devoted to foundry equipment and supplies, has been issued by J. W. Jackman & Co., Ltd., Manchester, Eng. In addition to English and continental types of equipment, many lines of American-made machines are shown, including core shop equipment, molding machines of various types, cupolas, core ovens, etc. This catalog is unusually well-illustrated. One section is devoted to foundry supplies, including facings, fluxes, etc., used in every casting shop.

BRASS FOUNDRY EQUIPMENT. — A bulletin recently issued by the J. W. Paxson Co., Philadelphia, is devoted to its extensive line of brass foundry equipment and supplies. Practically every type of furnace is illustrated, as well as crucibles, flasks, slip jackets, steel bands, flask pins and ears, bottom boards, clamps, ladles, etc. The supplies that can be furnished include facings, molding and core sands, etc. The bulletin is unusually complete and should prove a valuable addition to every brass foundryman's trade literature.

COUNTING MACHINES AND ELEVATING TRUCKS.—An exceedingly well-arranged and handsomely illustrated 36-page catalog has been issued by the National Scale Co., Chicopee Falls, Mass., which is devoted to its line of counting machines and elevating trucks. The counting and weighing machines are used for counting various classes of products and material in process of manufacture and can be used to advantage in shipping rooms, receiving departments, packing, stock and store rooms, etc; for piecework operations, inspection work, etc. The results are given in dozens or gross and the weight also is indicated. The elevating truck built by this company is mounted on four wheels, being hand-propelled, and can be used to advantage in practically all industrial operations.